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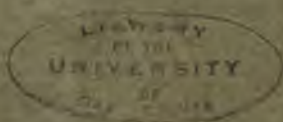
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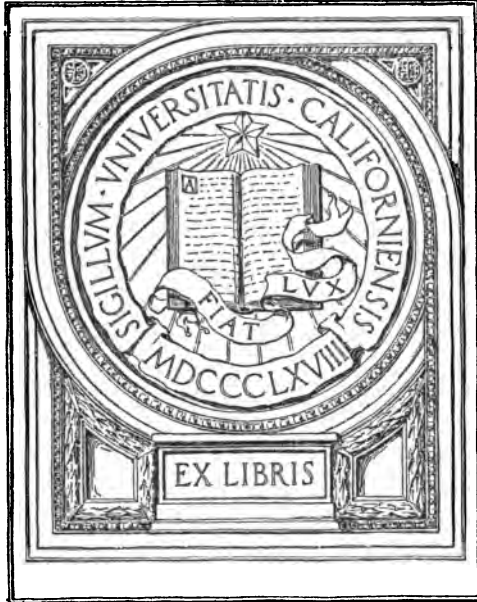
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# APPLE GROWING IN CALIFORNIA

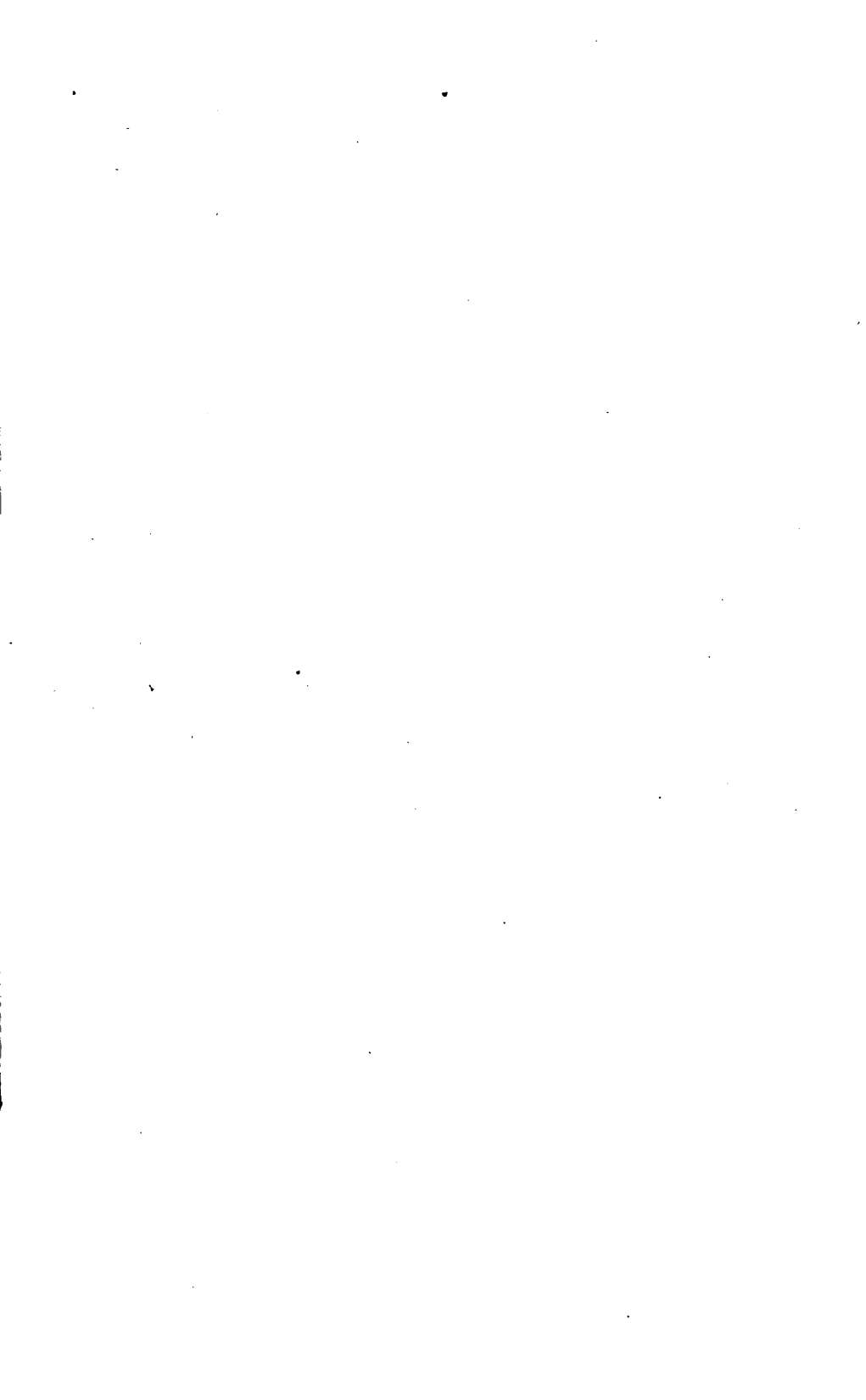


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# Apple Growing in California

A Practical Treatise Designed to Cover Some of the  
Important Phases of Apple Culture  
Within the State

By GEO. P. WELDON  
Chief Deputy State Commissioner of Horticulture

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## PREFACE.

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The great importance of the apple in our state, the many failures among those who have attempted to grow this fruit, the common opinion that an apple orchard can not be made a paying proposition, and the hopeless neglect and consequent failure to produce what might be beautiful and profitable orchards, together with a dearth of literature on the subject, are some of the things that induced the author to write this little book. It is published with a realization of its incompleteness and possible errors, but if it will in a small way, at least, serve as a guide to future profitable apple culture in California, the efforts put forth will in no way be regretted.

While primarily a treatise on apple culture, several of the chapters are designed to teach lessons that will be valuable in the culture of other fruits: For example, chapters on Pruning, Intercropping and Cover Crops.

I wish to express thanks to Dr. A. J. Cook, under whose direction the investigations were conducted, and who has at all times cooperated with me in the work. His valuable assistance in reading the manuscript is appreciated.

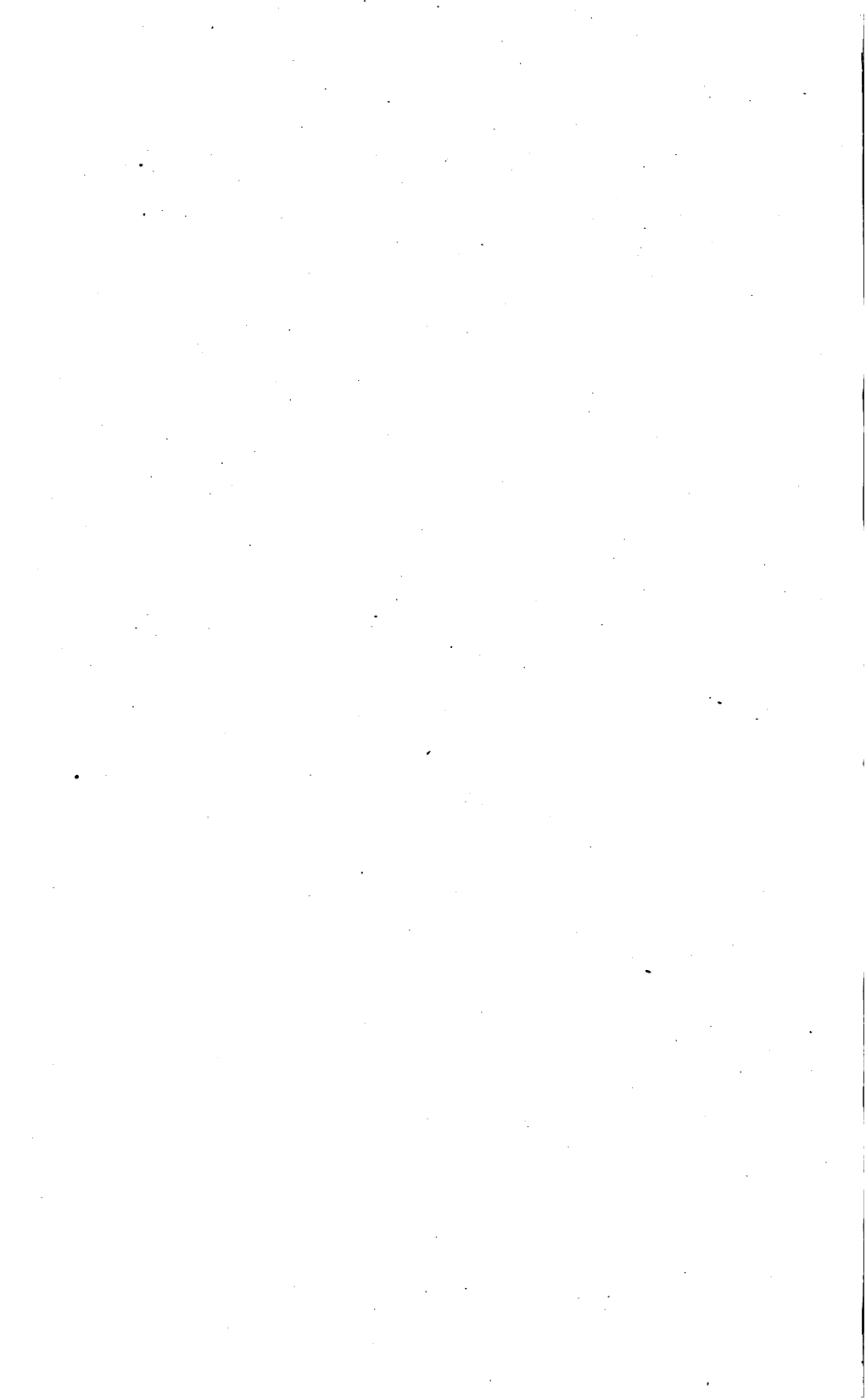
Thanks are also due Prof. A. V. Stubenrauch, Pomologist of the State University at Berkeley, Mr. W. H. Volck, County Horticultural Commissioner of Santa Cruz County and Mr. W. S. Ballard, Pathologist, Fruit-Disease Investigations, United States Department of Agriculture, each of whom kindly read parts of my manuscript; also to Mr. E. J. Vosler, Secretary of the State Commission of Horticulture and Mr. H. S. Smith, Superintendent of the State Insectary, for the same courtesy.

For illustrations I am indebted to the State University, Mr. C. B. Weeks, County Horticultural Commissioner of Tehama County, Mr. O. E. Bremner, County Horticultural Commissioner of Sonoma County, and Mr. J. F. Benton of Arcata.

GEO. P. WELDON.

Sacramento, California, November 5, 1914.





# APPLE GROWING IN CALIFORNIA.

## CHAPTER I.

### STATISTICS.

There is no more cosmopolitan fruit among the long list grown, than the apple. It adapts itself to the cold climates of the north as well as to the more temperate regions farther south. Practically every state in the Union boasts of some places where apples can be produced, and as far north on the continent as British Columbia we find them doing remarkably well. The climate and soil in many parts of California are admirably suited to the growing of this fruit. Prof. E. J. Wickson, in his "California Fruits," divides the state into five regions, viz: northern coast region, central coast region, interior valleys and foothills, mountain valleys and plateaus, and southern California, and gives a long list of varieties that are adapted to the diversified conditions of these regions. The central coast region has so far produced a very great part of the state's output of apples, in fact is the only region which has taken up apple orcharding on a large scale. With splendid transportation facilities and with conditions of soil and climate such that certain varieties have done well, Santa Cruz and Sonoma counties, despite their low elevation and frequent fogs, have produced Yellow Bellflowers, Yellow Newtowns and Gravensteins, that have made them famous. The northern coast region, including within its borders Mendocino and Humboldt counties, is fast coming to the front, and the vast region classified under the name of "mountain valleys and plateaus" contains an abundance of land upon which apples of superior quality can be grown. From an elevation of about 2,000 to 6,000 feet along the Sierra Nevada range may be seen orchards and remnants of orchards in practically all of the counties which extend into these mountains. Fig. 1 shows an orchard at an elevation of about 5,000 feet. Transportation facilities are not such at present as to favor these sections, and since the markets are well supplied with shipments from Watsonville and other railroad points, the pioneer orchardists of the mountains have been forced to give up their practice of hauling the crop a long distance and the orchards no longer paying are neglected. Many splendid trees in some of these old remnants of orchards may still be seen, indicative of the possibilities of apple culture in the mountainous parts of the state.

The economic value of the apple is probably greater than that of any other fruit. Its cosmopolitan nature has made it a favorite for planting, and its food value is such as to make it prized above all our fruits. The cry of overproduction has rung in our ears until we wonder sometimes that any one has the nerve to go into the business. Despite this cry there is still a good profit to be made from the well cared for orchard of good varieties, well grown and packed. The apple business of the future must go to those sections where the fruit can be produced best, for small, gnarly apples will not pay for the expense of growing them, while the



Fig 1.—Orchard scene near Sugar Pine, Madera County, at an altitude of approximately 5000 feet. (Original)

finer grades will command a handsome price. Undesirable varieties in each locality must be weeded out, either by their removal entirely or by grafting them over to desirable varieties. The orchard containing as many varieties as there are trees must give way to one of only a few of the best. Specialization is the keynote to success in the apple business, as elsewhere, and only the sections which unite in the growing of a few well adapted varieties can hope to gain a reputation for their product and the market which as a consequence will be created.

It is a well known fact that the acreage planted to apple trees in recent years has been very large, and this fact has been a cause for alarm among those already in the business and has discouraged planting among others. One of the chief factors limiting the production of apples



Fig. 2.—Orchard scene near Julian, San Diego County. (Original)

is frost, and practically every state where they are grown is subject to periodical injury from it, and because the acreage of this fruit is great, it does not necessarily follow that the crop will be great every season, and prices low as a consequence. This one factor, frost, has driven many a man in the apple business to the "wall," and no doubt will continue to drive others, for planting in frost-subjected areas, because of an occasional good crop, will never entirely cease. California can boast of areas that are as free from killing spring frosts as any that may be found, and one who is growing fruit of any kind may feel reasonably sure of a fairly good crop annually. This assurance of an annual crop in many parts of California is not possessed by states less fortunately situated, and is a great point in her favor.

At the present time the apple business is somewhat discouraging, but there is no reason to doubt that the time will come when it will be good again. Periods of low prices always have a tendency to weed out many unprofitable orchards, thus decreasing the acreage to the decided advantage of those that are properly cared for or more favorably situated.

In the annual reports received from the county horticultural commissioners for the past year, the bearing and non-bearing acreage of apples in the various counties where these officials are at work, was given. A table, which follows, has been compiled, showing the counties from which these reports came, and the number of acres in each case.

TABLE GIVING ACREAGE OF APPLES.

County	Bearing	Non-bearing
Alameda	136	100
Butte	500	490
Contra Costa	160	80
El Dorado	350	200
Glenn	78	140
Humboldt	1,100	
Inyo	1,000	1,100
Kern	100	1,857
Lake	135	62
Los Angeles	1,400	300
Madera	200	70
Mendocino	948	130
Merced	60	40
Modoc	265	335
Monterey	4,500	600
Nevada	1,500	200
Placer	450	
Riverside	498	2,419
Sacramento	344	200
San Benito	325	150
San Bernardino	1,024	10,131
San Diego	1,110	271
Santa Barbara	400	150
Santa Clara	430	624
Santa Cruz	15,000	1,300
Shasta	300	140
Siskiyou	800	1,250
Sonoma	6,968	5,167
Stanislaus	113	20
Sutter	200	50
Tehama	500	
Tulare	300	100
Yolo	25	
Yuba	430	75
Total	41,649	27,891

During the past summer a list of twelve questions was sent out to one hundred and eighty apple growers in the following counties: Butte, El Dorado, Fresno, Humboldt, Madera, Mendocino, Monterey, Riverside, San Bernardino, San Diego, Santa Cruz, Sonoma, and Tehama. Sixty-eight out of the total number to whom the list was sent responded, and the answers to these questions contain so much of interest that a table has been prepared, giving them in full just as they were received, with the exception of question No. 12, which is answered under the heading "Varieties."

Following is the list of questions and the table, in which the numbers in first column correspond to those in list:

1. How many packed boxes of apples per tree do you consider an average crop for your orchard?

2. How many packed boxes per tree do your heaviest bearing trees produce?

3. How old are your trees?

4. What per cent of your apple crop is packed?

5. What per cent is dried?

6. What per cent is made into cider, jelly, vinegar, or sold locally? Indicate which.

7. What is the average price per pound net to the grower, for dried apples?

8. What is the average price per box to the grower for packed apples?

9. What is the approximate elevation of your orchard?

10. Do you practice thinning?

11. Is your orchard irrigated?

Questions	Butte County			El Dorado County			Fresno County			Humboldt County				
	3-5 10 15 years	3 5-6 25 years	5 10 20-40 years	5 10 17 years	8 14-15 12 years	8 16 25 years	25 20-30 15-17 years	25 40 25 years	6 10 10 years	25 40 25 years	16 years	80% None None	100% None None	95% None None
1	3-5	3	5	5	8	8	25	25	4	25	16 years	20%	100%	95%
2	10	5-6	10	10	14-15	16	20-30	40	10	40	25 years	80%	100%	None
3	15 years	25 years	20-40 years	17 years	12 years	25 years	15-17 years	25 years	10 years	25 years	16 years	20%	100%	95%
4	25%	75%	95%	100%	75%	80%	85%	80%	95%	80%	20%	80%	100%	95%
5	None	None	None	Culls	15%	None	None	None	None	None	80%	None	100%	None
6	None	50% L	5% C, J	1% L	10% L	10% L	20% L	None	None	None	80%	None	100%	None
7	L	50% L	5% C, J	1% L	10% L	10% L	20% L	None	None	None	80%	None	100%	None
8	\$1.00	\$0.60	\$0.50	\$1.00	\$0.75	\$15 ton unpacked	\$0.63	\$0.65	\$0.80	\$0.65	\$0.65	\$0.65	\$1.10	\$0.80
9	1700 feet	3700 feet	1850 feet	3000 feet	4000 feet	50 feet	200 feet	130 feet	70 feet	130 feet	130 feet	130 feet	400 feet	70 feet
10	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
11	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No

Questions	Madera County			Merced County			Monterey County		
	8 15 10-35 years	6 10 7-15 years	2-25 years 75%	1-40 years 75%	5-15 years None	14 years 100%	23 years	300 feet No	98 feet Yes
1	8	6	?	?	10	14 years	23 years	300 feet	98 feet
2	15	10	25	25	20	14 years	23 years	300 feet	98 feet
3	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
4	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
5	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
6	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
7	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
8	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
9	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
10	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet
11	10-35 years	7-15 years	2-25 years	1-40 years	5-15 years	14 years	23 years	300 feet	98 feet

C—Cider.

J—Jelly.

V—Vinegar.

L—Local market.

\*Number of columns under name of county indicates number of orchardists reporting from that county in each case.

Questions		Riverside County									
1	2	1	2	5	3	6	3	4 years	3	3-4 years	
2	4	1	3	17	4	14	4	4 years	4	4 years	
3	5 years	5 years	5 years	1-33 years	7 years	5-13 years	1-7 years	4 years	1-7 years	3-4 years	
4	100%	100%	All	75%	70%	75%	96%		96%		
5	None	None	None	None	10% C	15% L	None		2% C		
6				5% C	10% C	10% C	3% V		3% V		
7						\$0.10					
8	\$1.00	\$1.25	\$1.25	?	\$1.00	\$1.20	\$2.00	2900 feet	5200 feet	3000 feet	
9	2800 feet	3000 feet	2700 feet	4300 feet	3000 feet	5250 feet	Yes	Yes	Yes	Yes	
10	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	
11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Questions		San Bernardino County									
1	9	6	6	2	6	5	1	1-15 years	5	1	
2	20	25	20	18	15 years	25	1	100%	25	5 years	
3	6-21 years	15 years	16 years	11 years	90%	14 years	99%	100%	90%	99%	
4	90%	None	90%	75%	None	90%	None	100% L	90%	None	
5	None	1% J, 8% L	None	5% L, 5% V	1% J, 8% L	1% C	1% C	100% L	1% C	1% C	
6											
7											
8	\$1.40	\$0.75 on trees	\$1.00	\$1.25	\$0.75 on trees	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	
9	4800 feet	4800 feet	5000 feet	4200 feet	4800 feet	5000 feet	5000 feet	5450 feet	5000 feet	6100 feet	
10	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	
11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	

C—Cider.  
J—Jelly.  
V—Vinegar.  
L—Local market.



## APPLE GROWING IN CALIFORNIA.

Questions	San Diego County									
	10	6	3	5	2	10	16	5	12	
1	25	15	30	20	15	50	30	9	20	
2	25 years	25 years	10-30 years	16-20 years	15 years	22 years	16-20 years	20 years	25 years	
3	90%	60%	95%	80%	90%	66%	95%	50%	75-90%	
4			None				None			
5	5% L	30% L	2% V			33% L	1% L	50% C, J, V	24% J	
6										
7										
8	\$0.75	\$0.75	\$0.60	\$0.60	\$0.64	\$0.75	\$0.75	\$0.50	\$1.00	
9	5000 feet	3500 feet	4200 feet	3000 feet	5200 feet	4000 feet	4300 feet	3800 feet	3300 feet	
10	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	
11	No	Yes	No	No	No	No	No	No	No	

Questions		San Diego County									
1	3	4	7	6	8	4	4	3			
2	10	15	10	9	12	15	15	10	4	10	
3	14-23 years	15-20 years	15 years	12-20 years	15 years	10-25 years	10-25 years	14 years	20 years	20 years	
4	75%	75%	75%	80%	70%	50%	50%	90%	75%	75%	
5		15%			15%	25%	25%	5%	20%	20%	
6		10% C			15% J	25% V	25% V	2% C, 3% V			
7			5% C, V		\$0.08	\$0.03	\$0.03				
8	\$0.50	\$0.40	\$0.05	\$0.25	\$0.50	\$0.50	\$0.50		\$0.45	\$0.45	
9	1000 feet	100 feet	1000 feet	35 feet	100 feet	70 feet	70 feet	50 feet	50 feet	50 feet	
10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
11	No	No	No	No	Yes	No	No	No	No	No	

C—Cider.  
J—Jelly.  
V—Vinegar.  
L—Local market.

Questions	Sonoma County										Tehama County
	8	10	4	4	8	4	7	11	6	2	
1	25	40	10	20	18	20	14	25	20	2	
2	12-25 years	50 years	10-35 years	3-20 years	13-16 years	30 years	20 years	15 years	30 years	10 years	
3	75%	76%	40-50%	50%	66%	75%	75%	90%	50%	75%	
4	20%	20%	40%	50%	33%	20%	23%	10%	30%		
5	5% J	4% V	10% L	100% L		5% C	2% V		20% L		
6											
7	\$0.08	\$0.015	\$0.05	\$0.09	\$0.07		\$0.06	\$0.08	\$0.05	10% C	
8	\$0.75	\$0.40	\$0.75		\$0.80			\$1.00	\$0.75	15% L	
9		250 feet	50 feet			200 feet	600 feet	175 feet	130 feet	2500 feet	
10		Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	
11		No	No	No	No	No	No	No	No	Yes	

C—Cider.  
J—Jelly.  
V—Vinegar.  
L—Local market.

## CHAPTER II.

## VARIETIES.

It is interesting to note in connection with first choice of varieties in answer to question No. 12 (Name your leading varieties in the order of their importance), that one man, reporting from Butte County, places *Black Ben* first. Four reporting from El Dorado—and no two agreeing—gave their first choice as follows: *Rome Beauty*, *Esopus*, *Baldwin* and *Sutton*. One man from Fresno reports *Fameuse* as his first choice. Humboldt County is represented by six growers, giving their first choice as *Wagener*, *King*, *Esopus*, *Yellow Bellflower*, and two favored *Rhode Island Greening*. Two reports from Madera County were received, both giving *Winter Pearmain* as the leading variety for this section. In Mendocino County the following varieties are said to be the best by four who answered the questions: *Jonathan*, *Swaar*, *King* and *Baldwin*. One report from Monterey County places the *Yellow Newtown* first. Eleven orchardists reported from Riverside County, giving a leading place to the following: *King David*, *Esopus*, *Rhode Island Greening*, three favored *Rome Beauty* and five *Delicious*. Eight orchardists were heard from in San Bernardino County, one giving the *Jonathan* first place, two *Winesap* and five *Rome Beauty*. From San Diego County nine reports came, one giving *Jonathan* as the leading variety, one *Julian Duchess*, one *Paragon*, three *Yellow Newtown*, and three *Yellow Bellflower*. As would naturally be expected, only two varieties were given first place by nine of the leading orchardists reporting from Santa Cruz County; six favored the *Yellow Newtown* and three the *Yellow Bellflower*.

The second county in importance from the standpoint of production, viz, Sonoma, is represented in these answers by eleven growers, eight of whom favor the *Gravenstein*, one the *Alexander*, one the *Rome Beauty* and one the *Yellow Newtown*. One report from Tehama County gives the *Yellow Newtown* first place.

The following is a complete list of the varieties, arranged alphabetically as they were sent in, making a total of forty-eight in all, reported upon. Brief descriptions of twenty of these and illustrations of nine of the best follow, also a supplementary list of varieties not reported upon by growers, but most of which the writer has seen growing somewhere in the state, and which are recommended for trial by those who are experimenting with varieties. Thus a total of seventy-two varieties, not including the lists of summer varieties and crabs, is given. This contains practically all varieties commonly found, and it is hoped may serve as a guide in the selection of suitable kinds for future planting by some to whom this book may find its way.

## VARIETIES.

Alexander	Gravenstein	Red Pearmain
Arkansas	Grimes	Red Winter
Arkansas Black	Hoover	Rhode Island Greening
Baldwin	Jonathan	Rome Beauty
Banana	Julian Duchess	Smith
Ben Davis	King	Stark
Black Ben	King David	Stayman Winesap
Champion	Lankford	Sutton
Cook's Seedling	Lawver	Swaar
Delaware Red	McIntosh	Twenty Ounce
Delicious	Minkler	Wagener
Esopus	Missouri Pippin	White Pippin
Fall Pippin	Orange Pippin	Winesap
Fallawater	Ortley	Winter Pearmain
Fameuse	Paragon	Yellow Bellflower
Gloria Mundi	Red Astrachan	Yellow Newtown

## SUPPLEMENTARY LIST.

Bailey Sweet	Rambo
Bietigheimer	Romanite
Canada Red	Sheepnose
Keswick Codling	Sheriff
Maiden Blush	Smokehouse
Mann	Tolman
McMahon White	Utter
Northern Spy	Walbridge
Northwestern	Wealthy
Pewaukee	Wolf River
Plum Cider	York Imperial
Ralls	

## SUMMER VARIETIES.

The exceptionally early season for ripening of all fruits in parts of California opens up the possibility of growing summer varieties of apples that will reach the markets earlier than those from any other of our apple growing states. With San Francisco, Los Angeles, Sacramento and other large cities at hand, there should be a good local demand. For a great many years the Sacramento Valley river bottom below Sacramento has grown Red Astrachans and other summer varieties to good advantage. The severe attack of the codling moth has probably done more toward discouraging growers than anything else. As this pest is entirely under the control of those who take the necessary pains to fight it in the proper way—as discussed in the chapter on “Insect Pests of the Apple”—there is no good reason why it should put any one out of business. With proper attention to pruning, spraying and cutting out blight, along with the proper handling of the soil, much greater returns should be realized than those of the average grower at present.

The following list of varieties is printed in the order of their ripening. They are all good, each one having some special characteristics to commend it:

Early Harvest	Yellow Transparent
Oldenburg	Red Astrachan
Red June	Chenango

**CRAB APPLES.**

Crab apples will always be prized by many for making jelly, pickling and preserving purposes. To those who wish to set out a few trees the following list of varieties is recommended:

Florence	Siberian, Red or Yellow
Hyslop	Transcendent
Martha	Whitney

**ARKANSAS.<sup>1</sup>**

The above variety is probably better known under the name of Mammoth Black Twig, and is grown only to a very limited extent in the state. It is of the Winesap type, probably a seedling from it, but of somewhat inferior quality. The keeping qualities are about the same. Under some conditions it is quite subject to the Baldwin spot disease.

The trees are very large and thrifty and are inclined to be uncertain bearers.

**ARKANSAS BLACK.**

This variety closely resembles the Winesap and is thought to be a seedling from it. In some parts of the state it is quite a popular variety, especially in southern California. It takes on a very deep red color, which polishes beautifully, making a good showing on the fruit stands, and usually commanding a ready sale. Quality is fair but somewhat coarse. Keeping qualities are excellent.

The trees are thifty growers as a rule, but are inclined to bear lightly in some sections of the country. Whether or not this applies to our California conditions the writer has been unable to determine.

**BALDWIN.**

There are few finer apples than this variety when at its prime. So far it has been grown to a limited extent in the state, being subject to an obscure disease known as Baldwin spot, which very often ruins it for market. In the East it is considered to be one of the standards. In a few favored localities in the mountains of California it has been found doing quite well, and in Sonoma County quite a large acreage has been planted, and with a few of the orchardists it is a popular variety.

The trees are strong growers.

**BLACK BEN.**

While in times past the old Ben Davis apple has not only been a great producer but a money maker as well, there is little excuse at this time of keen competition among growers of superior varieties for planting it. Its place may be taken by the far superior Black Ben or Gano. While the quality of this apple is little if any better than the first mentioned, the beautiful color makes it a good seller. It is not good judgment to advertise a fruit because of color—not taking into consideration the quality—yet as long as people prefer a red apple regardless of what is inside the skin, this will be a favorite variety. The keeping qualities are on a par with those of the common Ben Davis.

Trees are ordinarily healthy and thrifty growers, and are inclined to bear regularly and heavily. If one wants to plant a Ben Davis apple, and still have a variety that sells well, this one should commend itself and should do well in sections where color attains its maximum in varieties.

<sup>1</sup>Mammoth Black Twig.

**DELICIOUS.**

(Fig. 3.)

This being one of our newest varieties, has not been tested in the state sufficiently to determine its true value. It is, however, quite promising in certain parts of the foothills and mountainous sections of southern California. The quality is of the best and there are few



Fig. 3.—The Delicious. (Original)

apples more juicy and pleasant to the taste than this one, when in its prime. The shape is very irregular, making it a somewhat difficult variety to pack. The keeping qualities are good.

Where this variety has been observed in the state, trees have done well, and have come into bearing quite early. Whether or not it will be a steady bearer remains to be seen. Indications at present are that it will be one of our best varieties in certain sections. Figure 4 shows a fine tree of this variety in the Frank Femmons orchard near Oakhurst.



Fig. 4.—A heavily loaded tree of the Delicious variety near Oakhurst, Madera County. (Original)

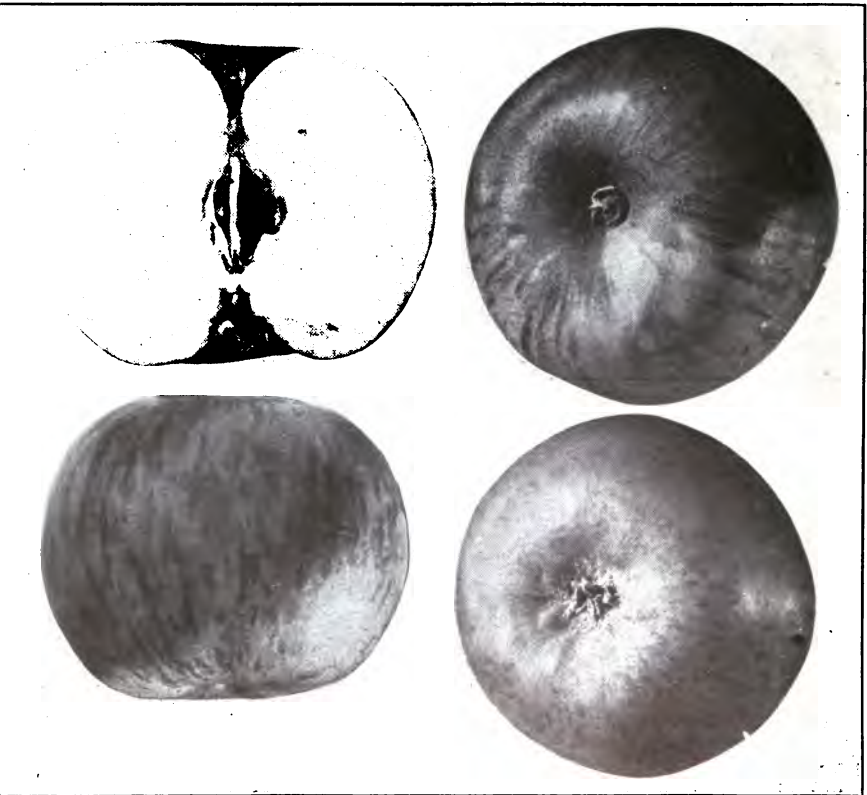


Fig. 5.—The Gravenstein. (Original)

**GRAVENSTEIN.**

This very popular fall variety has been grown extensively only in the Sebastopol section of Sonoma County and has there reached its greatest perfection. It has been found doing well in many parts of the state. The Gravenstein is a favorite for general use during its season. When well colored it is golden yellow, beautifully streaked with red. The stem is very short and there is sometimes considerable trouble experienced with the dropping of the fruit before it is ripe. The loss from dropping may be greatly lessened by careful thinning. It may

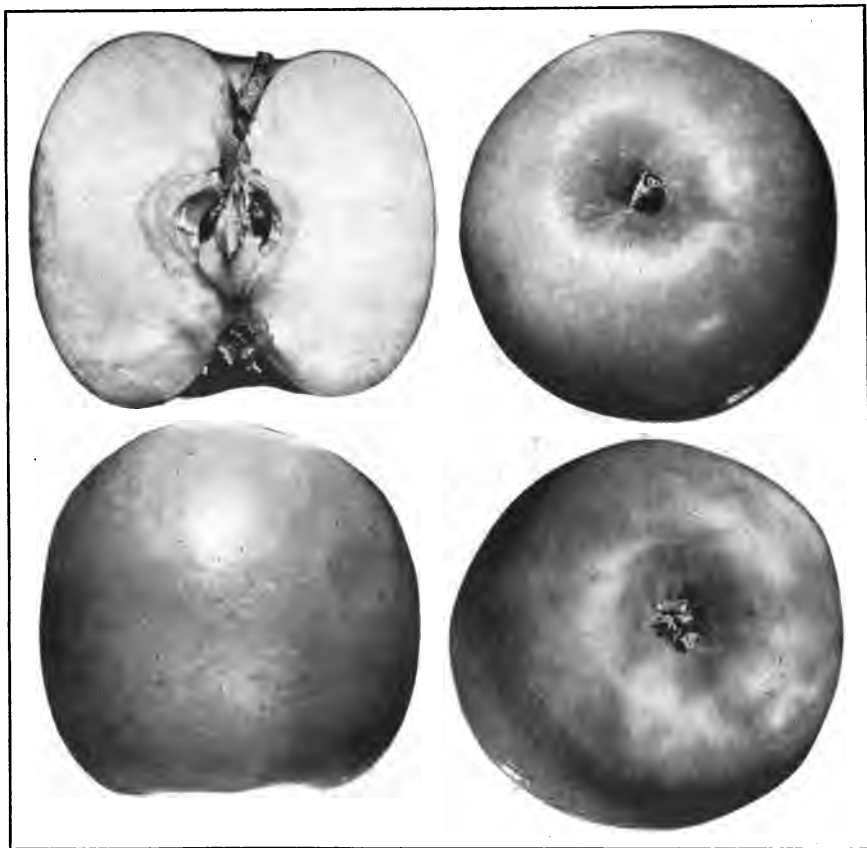


Fig. 6.—The Grimes. (Original)

be kept in cold storage for two or three months, but is inclined to go down rapidly upon being removed.

In California the trees are usually thrifty and inclined to make quite a strong, heavy growth.

The great success that has come to the apple growers of Sonoma County in growing this variety has made it standard for that section, and has illustrated the value of specializing in the apple business.

**GRIMES.\***

During the investigations preparatory to the publication of this work, the above apple has not been commonly found growing in the state,

\*Grimes Golden Pippin.



and is deserving of trial by those who are experimenting with varieties, as it is a showy apple of excellent quality, being popular both for eating and cooking purposes. Like most other apples of a light color it is somewhat delicate and must be handled with care. Keeping qualities are not very good, but no doubt vary much with apples from different localities.

The trees are fairly thrifty when grown on soil suited to them.

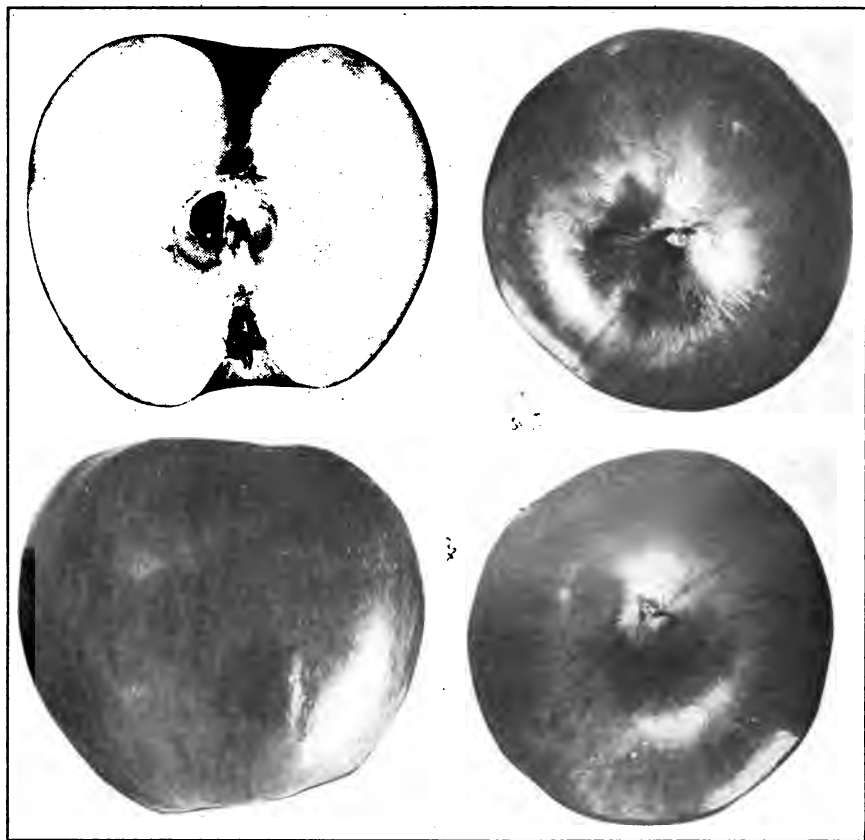


Fig. 7.—The Jonathan. (Original)

Only an occasional one has been observed in this state, but on these some very fine specimens were growing. It is recommended for trial in the mountain sections, especially of southern California.

#### JONATHAN.

(Fig. 7.)

This excellent variety has not been grown extensively in the state, but there are places in Riverside, San Bernardino, San Diego, El Dorado, Mendocino and Humboldt counties, at least, where it has done well. Its beautiful red color, combined with excellent quality, makes it

a favorite. When picked before too ripe it is a fairly good keeper, being in its prime during the holidays. In storage it is subject to a condition known as Jonathan spot, and should not be held long after the first of January.

The tree is inclined to be small under most conditions, and it should not be set except in good and well-adapted soil, and is not recommended for general planting in the state. Figure 8 is of a five-year-old Jonathan tree near Beaumont, and Figure 9 of an older tree, well loaded with fruit in San Diego County. In both the orchards where these pictures were taken the trees had made a splendid, thrifty growth, and the fruit they produced was of the best. Some splendid, well-colored specimens



Fig. 8.—Fine specimens of Jonathan trees near Beaumont, Riverside County.  
(Original)

have been received from the J. E. Hassler orchard at Placerville. The excellence that this variety attains in Utah and Colorado, and the highest market prices that are received by growers in these states, make it desirable that it be grown in California only where it will attain somewhere near the perfection that it does there. In general it is a fairly good producer, coming into bearing early and maturing crops with great regularity.

Trees should be pruned heavily for the first five years, and the greatest strength of scaffold branches developed, as they have a tendency to grow slender and willow-like, thus being unable to hold up a heavy load of fruit to the best advantage.

#### KING DAVID.

This beautifully colored variety is becoming quite popular in some sections of the state, but as yet has not been thoroughly tested out under California conditions. In some of the newer sections of Riverside and

San Bernardino counties it is being planted quite extensively. The appearance is strikingly like that of the Jonathan, but the flavor and quality are somewhat inferior.

It is too soon to predict what the future for this variety will be. So far it has done well from the standpoint of growth of trees and production of fruit.

#### ORTLEY.

The Ortley or White Bellflower does remarkably well in parts of the foothill region. In Placer and Mariposa counties this variety has



Fig. 9.—Well-loaded Jonathan tree near Julian, San Diego County. (Original)

attained a high degree of excellence, and apples have been sought after for table use. It is an apple similar to the Yellow Bellflower, but of better quality. Like many of the light skinned varieties it is exceedingly delicate and susceptible to limb scars and blemishes from other injuries. The season is about with that of the Jonathan and the two varieties together on the table make a veritable bouquet.

The trees are normally thrifty and good bearers.

**ROME BEAUTY.**

The Rome Beauty is quite a general favorite for planting in certain sections of California, where it is known to do well. When highly colored it is one of our finest appearing apples. Flesh is very firm and of good quality. The keeping qualities are of the best and specimens may be held over from one season to another. There are few apples that command a higher price than this one when in its prime.

The trees are inclined to be somewhat small, and of upright habits



Fig. 10.—The Rome Beauty. (Original)

of growth, unless on very favorable soils. They come into bearing early and are usually heavy and consistent producers. Because of a late blooming habit this variety often escapes early spring frosts that mean disaster to those varieties that bloom earlier. For this reason it is an excellent variety to plant in sections where damage frequently takes place from such frosts. Trees are quite susceptible to the attack of woolly aphis, green apple aphis and other species which affect apple trees.

Some of the finest specimens of this variety that the writer has ever seen came from the Yucaipa section of San Bernardino County. There are several orchards in this section at an elevation of about five thousand feet where Rome Beauties are grown. Mr. Geo. Rowe of Grand Rapids, Michigan, who has been head judge of the California apple show each season since its organization, has seen specimens of the variety from this section and considers them to be extra fine. Coming from an



Fig. 11.—Young Rome Beauty tree with heavy load of fruit; Yucaipa, San Bernardino County. (Original)

authority on apples such as he is, this information should mean something to the people of the Yucaipa district.

Figure 11 is of a young Rome Beauty tree on the E. N. Boyd place near Yucaipa, which illustrates the heavy bearing tendency as well as the young age at which they come into bearing.

No doubt there are other places in the mountain sections, away from the coast especially, where this variety will do well.

**RHODE ISLAND GREENING.**

This old New England variety has been found doing well in Humboldt County, and again in the extreme southern part of the state in San Diego County. The quality of this apple is good and it keeps well in storage.

The trees are strong and vigorous and are seemingly productive where grown in the state.

**ESOPUS.\***

This excellent apple has not been known to reach the high degree of perfection in California that it does in the Northwest, although it does pretty well in some places. The good keeping qualities and excel-

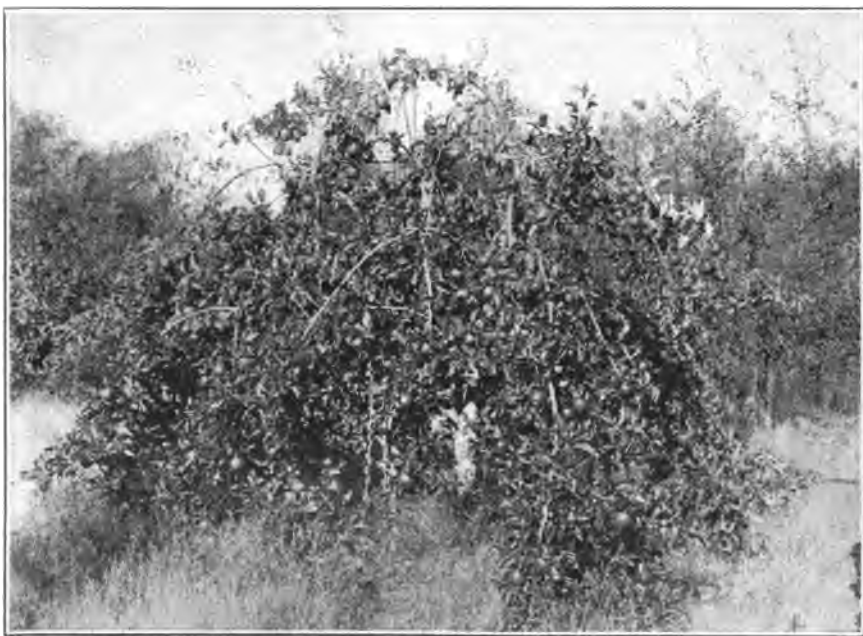


Fig. 12.—Stayman Winesap tree bearing heavily in Tehama County. (Photograph by C. B. Weeks)

lence in general commend it to a great many people and it finds a ready sale in our markets.

In California it is generally subject to scab and aphids, the trees themselves being moderately healthy. There are a few people in the state who will recommend it, and there may be some favorable localities where it will do well.

**STAYMAN WINESAP.**

The Stayman is a seedling of the old Winesap, which attains a greater size, but not quite such a good color. The quality is probably a little inferior to that of its parent. The keeping qualities of the two are about equal, both being in season about January first and lasting

\*Spitzenberg.

through the winter. At present it is not grown extensively, but is a very promising variety, especially in the apple sections of San Bernardino, Tehama and Riverside counties. Figure 12 shows a tree in Tehama County bearing heavily.

The trees are usually as thrifty as the regular Winesap. It has been rated as a light bearer, but may not be under California conditions.

#### WAGENER.

Some splendid apples of this variety have been seen in Humboldt County, and the northern counties to the south, viz: Mendocino, Sonoma



Fig. 13.—The Winter Pearmain. (Original)

and Napa, also seem to be well adapted to its growth and development. At its best it is a nicely colored apple of excellent quality, and sells for a good price. It is rather early and does not keep well, but should be consumed before the holidays.

The trees are small but heavy bearers. This variety, probably more than any other, has been used as a filler in orchards of other varieties. It is quite subject to the blight in some localities, and is not considered to be a long lived tree.

## WINTER PEARMAIN.

(Fig. 13.)

Among the list of green colored varieties there are few of better quality than the Winter Pearmain. This variety has been quite extensively planted in the past in California and there are few of the older orchards where it can not be found. It is a good keeper and during the holiday season is in its prime, though it keeps well for a long time afterward. On some of the lighter soils quite a little color is produced,

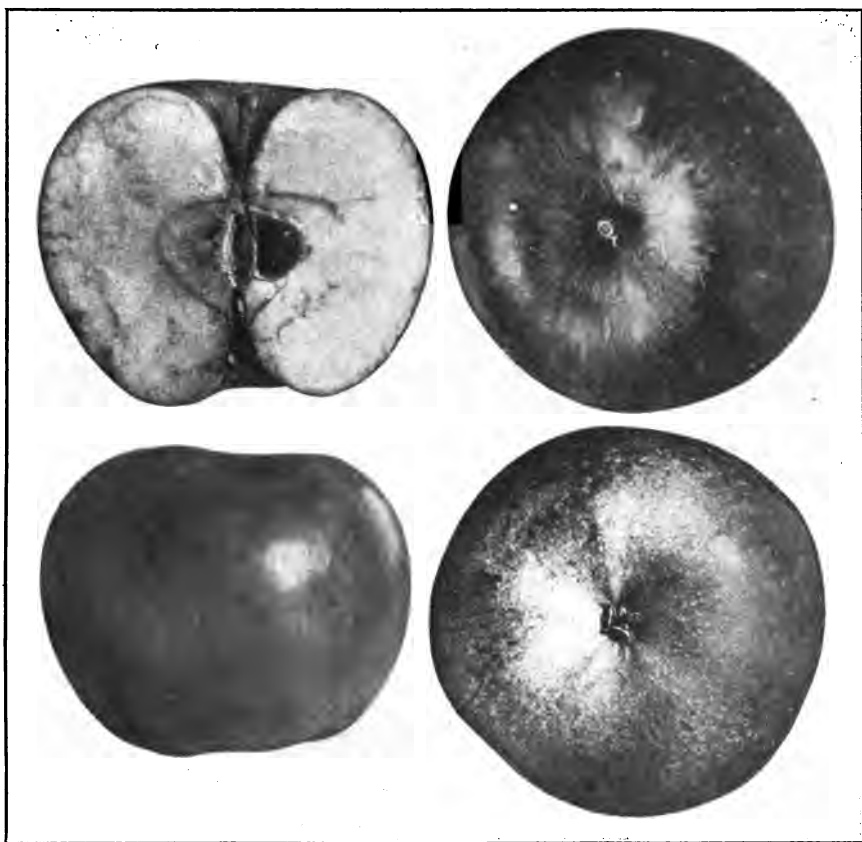


Fig. 14.—The Winesap. (Original)

thus adding to its attractiveness and selling qualities. This apple, if it had a red skin, would be much more popular.

The trees are exceedingly productive in this state, in some places bearing crops almost annually. If the soil is at all suitable good growth takes place, and if pruning and thinning are practiced consistently good fruit of uniform size and quality can be expected.

There are few places where the writer has been that this variety has not been found doing well. In the mountainous sections of Madera, San Bernardino and San Diego counties some excellent specimens have been seen, and in the Pajaro and Santa Clara valleys it has been grown, not extensively, but always with uniformly good results. Consequently it is recommended for use in practically all the apple growing sections.



**WINESAP.**

(Fig. 14.)

One of our most cosmopolitan, as well as generally popular varieties of apple, is the Winesap. While it is inclined to be small the quality is good, the red color such as to attract attention, and the keeping qualities of the best. It is an excellent winter variety for general use, and when at its best commands a high price. There are few of the older orchards in California where this variety is not found, and it has been quite extensively planted in the foothills sections. Some remarkably fine specimens have been taken in the Sierra Nevada mountains at an elevation of about five thousand feet.

The trees are inclined to grow bushy and ordinarily require heavy pruning. This applies to old as well as young trees. Not only is heavy pruning necessary to keep the trees in good shape, but also to induce the apples to attain a good size. The tendency is always for them to be small on older trees, unless pruning is properly done.

In the coast counties at low elevations this variety is not commonly planted, and is only recommended for the interior foothills and mountain sections.

**BANANA.\***

The beautiful blush of this variety has made it a favorite for planting in some sections. Like the Ortley and Grimes it is rather delicate and must be handled with great care in picking and packing. It usually does best at rather high altitudes, although some beautiful specimens which were grown in Santa Cruz County were exhibited at the recent California Apple Show. Some fine fruit is produced in Modoc County.

While a fairly good keeper ordinarily, it is at its best rather early in the season.

The trees are vigorous when young, at least, but are inclined to be rather stunted later, unless grown under the most favorable conditions.

**YELLOW BELLFLOWER.**

(Fig. 15.)

Probably nowhere else has the above variety been grown so extensively and reached such perfection as in the Pajaro Valley of this state, or what is better known as the Watsonville section, which includes parts of Santa Cruz and Monterey counties. The difficulty experienced in getting red varieties to color well in this section is no doubt responsible for the extensive planting to this variety and also the commonly grown Yellow Newtown, another light colored apple. When grown on favorable soil and when not picked too early it develops a blush that makes it very attractive. It keeps well until after the holidays and is a general favorite in California for the early market.

The trees grow very large and sturdy and in California bear quite regularly and their size after they reach the age of fifteen years or more, makes it possible for them to bear some very large crops. In most parts of the country it is rated as a light bearer.

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\*Winter Banana.

This variety is recommended for planting in most of the apple growing sections of the state, as it may be found doing well at high elevations, as well as places near sea level. Because of the fact that Watsonville has made a specialty of this variety it would probably not be good business judgment for other sections to plant it extensively, but it would be better for them to choose some variety known to do well under their conditions.



Fig. 15.—The Yellow Bellflower. (Original)

#### YELLOW NEWTOWN.

(Fig. 16.)

Like the Yellow Bellflower this variety is exceptionally well adapted to the conditions of soil and climate of the Pajaro Valley, and there reaches a high degree of perfection. These two varieties constitute by far the greater part of the acreage (about eighty per cent) planted to apples in that section. The Yellow Newtown ripens a little later than the Yellow Bellflower, is firmer and a better keeper. It is quite a

popular variety for the export trade as well as for general use. In California it is quite subject to mildew and scab and these diseases often play havoc with the trees and fruit where nothing is done to control them. Bearing begins reasonably early and good crops are the rule in the state.

The trees are quite large and thrifty but do not usually attain the size of the Yellow Bellflower.

There are few localities where this variety does not do well, and like the Yellow Bellflower it is recommended for planting in all apple sec-

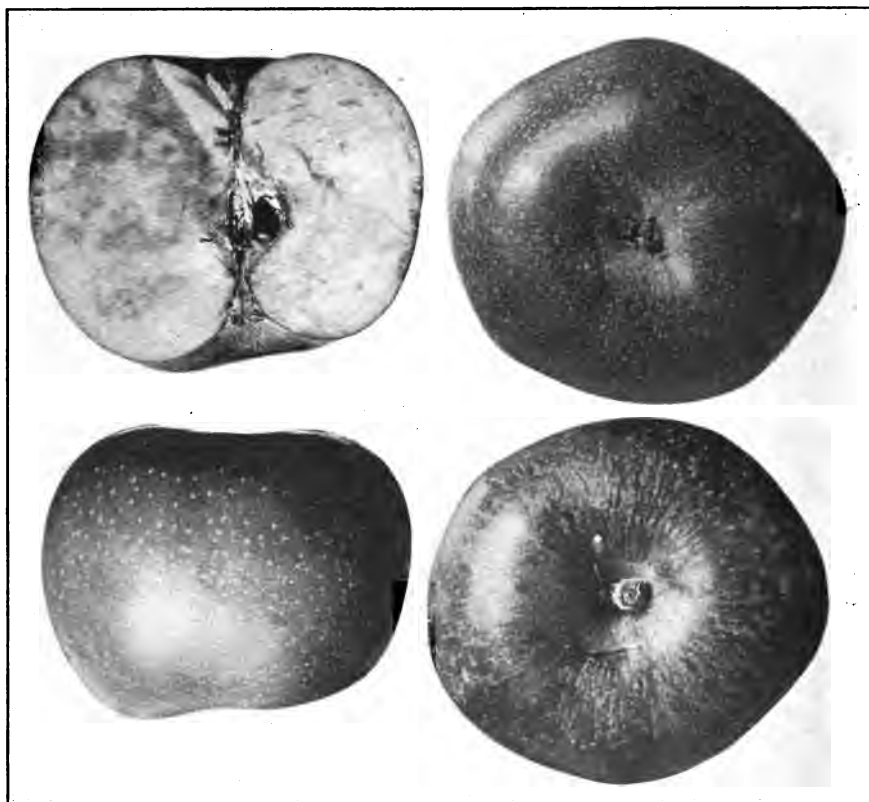


Fig. 16.—The Yellow Newtown. (Original)

tions of the state where a good light colored apple is desired. In Humboldt and Lassen counties in the north and in San Diego, Riverside and San Bernardino counties in the south fine specimens have been collected.

The trees will stand very heavy pruning, which becomes a necessity in sections where mildew is bad, as one of the best ways to control this disease is by pruning out infested twigs as they appear.

## CHAPTER III.

## PROPAGATION OF THE APPLE.

The work of propagating apple trees is usually left to the nurseryman, although there is no good reason why the person who is contemplating the setting out of an orchard should not propagate his own trees. In the past there has been frequent and serious difficulty experienced by the purchaser of nursery trees because of not receiving varieties ordered. The nurserymen of today, as a whole, exercise the greatest care toward sending out trees true to name, so the one-time serious objection to buying trees from them has been largely removed. It is true, however, that many nurserymen are not careful enough in the selection of the stock used for budding or grafting purposes, and as a consequence trees may not be inherently strong. The future will no doubt demand that more care be exercised to secure buds or grafts from trees that have a record of good crop production to transmit, or at least which they will surely have a tendency to transmit to trees developed from them.

## SEEDLINGS.

It is known by practically every one that the apple, when grown from seed, does not come true to the variety. That is, if a thousand trees were grown from seeds taken from a single Jonathan apple tree there would probably be none of them that would possess many of the characteristics of the true Jonathan. This fact necessitates the propagation of the apple by budding or grafting of fixed varieties into seedlings grown for the purpose. The first step, then, in developing trees for an orchard is the growing of seedlings.

Wickson recommends the following method of starting apple and pear trees from seed:

For a small lot of apple and pear trees the seed can be best sown in boxes. Select plump pips and keep in moist sand from the time they are taken from the fruit until sowing. Fill the boxes, which should be three or four inches deep, with good garden mold, cover the seed about half an inch, and then cover the soil lightly with chaff or fine straw to prevent the surface from drying out. Be sure that the boxes have cracks or holes in the bottom for drainage, and the whole is kept moist, but not wet. When the seedlings have grown to the height of three inches they can be set out in the nursery rows, as one would set out cabbage plants.

After these seedling trees have attained sufficient growth they may be budded to whatever varieties are desired.

Seeds for use in growing trees should be selected from good stock, if possible. Small, shrunken seed from poor apples is no more desirable than poor stock for budding purposes, as the thriftiness of the seedling tree will very largely determine the development and growth of the bud or graft that is inserted into it. Seeds are usually obtained from the pomace of cider mills. As such seeds from our American mills ordinarily possess nothing of uniformity in their makeup, a good stand of thrifty seedlings can scarcely be expected when grown from them. The best seedlings are those grown from the wild crabs of France, and most

of our nurserymen make a practice of buying either seedlings or seed from this French stock, which appears to have little value except for cider and seeds.

### BUDDING.

The budded apple tree is now generally preferred to the root grafted tree. The operation of budding is really more simple than grafting, the union of bud with stock is usually better than in the case of the graft, and the trees are believed to be less liable to attack by crown gall. For these as well as other reasons propagation by budding is practiced by most of our best nurserymen.

Budding can best be done in California in August and September, in which case the inserted bud unites with the seedling stem and remains

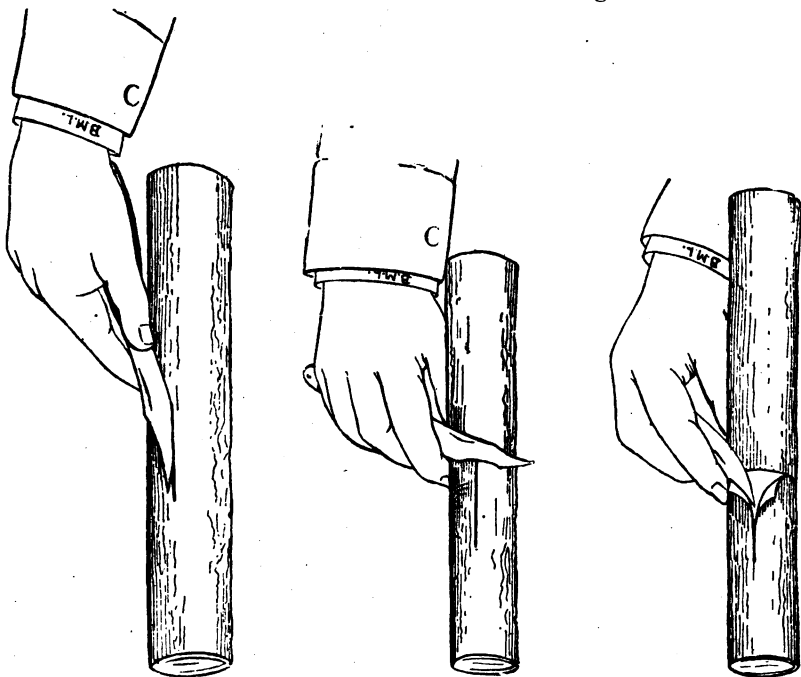


Fig. 17.—“Preparing the stock to receive the bud.” (After Lelong)

dormant throughout the winter season, making no growth until the spring. At this time the top of the tree should be removed, cutting just above the bud. The well established root system of the seedling will feed the new bud abundantly, and a rapid growth should take place, developing a satisfactory size of top for planting in one season.

Bud wood should be selected from bearing trees which have produced satisfactory crops, and only strong, healthy buds should be used. The practice of using bud sticks from young trees which have never borne, because of the convenience of securing them at the time of pruning, cannot result in the development of the best kind of nursery stock. In practically every orchard there are certain trees that have produced big crops of fruit year after year with scarcely a failure, while the average trees have not done nearly so well. Such heavy producing



Fig. 18.—“Cutting the buds from the scion.”  
(After Lelong)

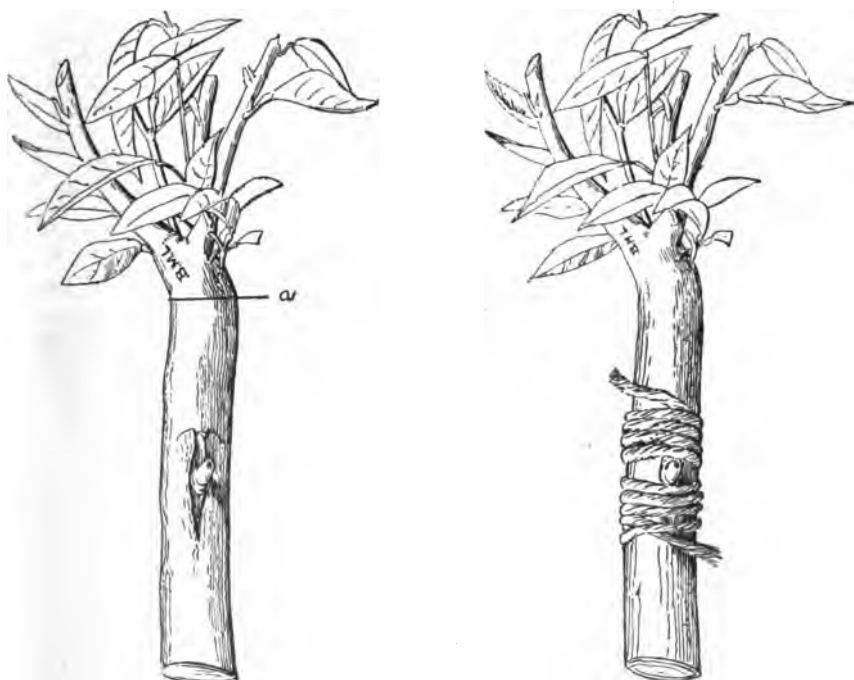


Fig. 19.—“Showing bud inserted and the wrappings. In some cases a few limbs are left to promote vigor.” (After Lelong)

trees, other characteristics being desirable also, should be the ones from which buds are taken. The orchardist usually has a better chance to utilize such trees than the nurseryman. The limited number of trees that he would need for his own use often makes it possible for him to secure bud wood from only one tree, which possesses more desirable characteristics of its kind than any other with which he is familiar. The wide breach between the quantity of fruit represented by the maximum producing trees of an orchard and the minimum, or even average producers, can never be greatly lessened until more careful attention is given to the selection of buds for propagating purposes.

The budding operation is quite simple and is well illustrated in Figs. 17, 18 and 19, after Lelong. These illustrations were made for use in a citrus publication, but as the operation with apples is similar, they serve the purpose in this book equally as well.

In the nursery an expert budder merely inserts the buds, the tying being done by some one else who immediately follows him. Either cotton twine or fibre from palm leaves, known as raffia, is used for holding the buds in place. As much care, if not more, is necessary in the tying of the bud as in placing it beneath the bark. The tying should be tightly done, thus binding the bud firmly to the stem and greatly facilitating its starting.

#### ROOT-GRAFTING.

This operation is accomplished by the use of seedling roots, whole or in part, to which bud wood of the desired variety is united. In the past this has been a very popular method of propagating nursery apple trees, but has been very largely superseded by budding, for reasons already given. Such grafts are usually made during the dormant season, and kept in wet sand or other suitable material until setting time in the spring.

## CHAPTER IV.

## SELECTION OF TREES FOR PLANTING.

Which varieties are selected should depend, first, upon their adaptation to the conditions existing where they are to be planted, and, secondly, upon whether they are to be used for commercial purposes or for a home orchard. If the orchard is planted for commercial reasons—and that is really all that need concern us in this article—only a very few varieties should be secured. What these shall be should be determined by careful observations of profitable trees in nearby orchards in a section, if older orchards can be found where information is easily obtainable; if not, similar conditions elsewhere may serve as a guide, but in this case the value of whatever varieties are planted will have to be largely determined by experiment. Every older apple section has passed through this experimental period, and, as a consequence, we find in our state many old orchards of a miscellaneous lot of varieties, some good and some bad. Such orchards very often do not have enough good trees in them to justify their existence on the ground they occupy. It is always a good plan to go slow with the testing out of new varieties. The nursery agent who understands his business as a salesman very often has no trouble in persuading people to buy varieties that, while they may be good, have never been tried out in the section, and should not form the major part of a new orchard. To test them out in a small way by planting only a few, until they are known to do well, is a commendable thing. Practically every apple section of any consequence in California has growing in it some well adapted varieties that have produced fine crops year after year. A few of such varieties, preferably not more than three, should be selected by the prospective grower. Success will come to a section when it can produce, in quantities, some variety or some few varieties of prime fruit better than any other section can produce them. An illustration of this may be found in the fine Gravensteins of the Sebastopol section of Sonoma County, or the Yellow Bellflowers or Yellow Newtowns of the Watsonville section of Santa Cruz County. With a miscellaneous lot of varieties, and no great quantity of any one, these famous apple regions would never have gained their reputation. In the mountainous parts of the state, especially that portion occupied by the Sierra Nevada range, may be found a great many other equally good varieties, such as Jonathan, Rome Beauty, Esopus, Winesap, Delicious, Winter Pearmain, Baldwin, Northern Spy, Maiden Blush and Ortley, any one of which, if grown extensively and handled well, should make a reputation for its section, as the previously mentioned varieties have done for Sebastopol and Watsonville.

Some varieties are more or less self-sterile, and unless interplanted with other varieties as pollinizers they may fail to produce well, if at all. With the limited amount of scientifically accurate work that has been done along this line, it is impossible to say just which varieties are self-fertile and will do well when planted alone. It is safe to say that large blocks of any variety should not be planted, for even though they may be self-fertile the effect of cross-pollination would undoubtedly be good.



The following table, prepared and published by Frederick Maskew,<sup>5</sup> shows the wide variation in time of blooming of a number of different varieties, something which should be taken into consideration when selecting two or more with the idea of getting the best results in cross-pollination.

Varieties	First bloom	Full bloom	General fall of bloom
Winter Pearmain .....	April 11th	April 27th	May 5th
Red Astrachan .....	April 17th	April 30th	May 12th
Yellow Bellflower .....	April 20th	April 30th	May 16th
Fall Pippin .....	April 20th	May 5th	May 15th
Rhode Island Greening .....	April 20th	May 5th	May 15th
Kentucky Red Streak .....	April 20th	May 10th	May 20th
Early Harvest .....	April 21st	May 6th	May 12th
Shockley .....	April 27th	May 15th	May 20th
Fameuse .....	April 27th	May 15th	May 22d
Ben Davis .....	April 29th	May 15th	May 23d
Winesap .....	May 5th	May 17th	June 1st
Yellow Transparent .....	May 5th	May 16th	June 1st
None-such .....	May 7th	May 16th	June 1st
Missouri Pippin .....	May 10th	May 20th	June 1st
Alexander .....	May 15th	May 25th	June 1st
Smith .....	May 15th	May 25th	June 6th
Transcendent Crabs .....	May 30th	April 7th	April 22d
Hyslop Crabs .....	April 11th	April 22d	April 30th
Montreal Crabs .....	April 16th	April 24th	May 7th

#### DEMAND THE BEST.

Having selected suitable varieties only the best trees should be considered for planting. Generally speaking, a cheap tree is a poor tree. In any nursery there are a certain number of trees which have never made a good growth and which on being dug are sorted out as low grade trees and sold for a lower figure than those which have been thrifty. Frequently these stunted trees never develop into first-class trees, no matter how great care they may receive. Trees possess an individuality which must be taken into consideration. Often being grown from buds selected miscellaneously, it is to be expected that there will be considerable variation in their size, hardiness and habits of growth. While it may be possible to build a fairly good tree from one which possesses many undesirable characteristics, yet it is much safer to choose the very best, which are likely to be inherently strong, and which will consequently respond readily to good treatment.

#### AGE OF TREE TO PLANT.

All things considered, the best apple tree to buy is the one year old whip. Such a tree has a three year old root system—two years' growth as a seedling, and the third as a budded tree. Thus the top is only one year of age when the roots are three, and all the plant food which they take up is utilized in developing this one year old top, which normally makes a thrifty and healthy growth with little or no branching. When set, trees of this kind should throw out branches in abundance throughout the entire length of the trunk, a very desirable thing, as a certain type of head being wanted there will be no trouble in selecting branches to conform to that type, and uniformity may be attained in the

<sup>5</sup>Apple culture in Los Angeles County.

heading of an orchard. In the case of the two year old tree it is usually headed a certain height in the nursery row, generally higher than is desirable for the orchard tree, and uniformity of heading is exceedingly difficult to secure. Sometimes such trees when set are denuded of branches, a mere whip being left, but when this is done they do not make as much lateral growth as the one year old tree, and it may be very difficult to select branches of the right height and properly spaced for the best type of head.

#### FREEDOM FROM DISEASE AND INSECT PESTS.

Thanks to the very careful inspection work in California, under the direction of the county horticultural commissioners, trees are usually quite free from recognizable diseases and insect pests, when they are set. Trees infested with such diseases as crown gall and such insect pests as woolly aphis are seldom planted. Our inspection system, while far from being perfect, has not only been successful in the detection of disease and insect pests, but it has also resulted in greater care being exercised by the grower of nursery trees, that they be clean. It is not always possible for the inspector to detect crown gall in its first stages, but the fact that he is always looking for it and destroying trees upon which it is found, has made the nurseryman realize his obligation relative to this trouble, and as a consequence trees are not grown on land after it becomes thoroughly infected with the disease, as they were at one time. This illustration is one of many which might be given to show that the tendency nowadays is toward better stock, as far as insect pests and diseases are concerned. It is of the utmost importance for new sections to plant clean trees, as by so doing many years may elapse before some of the very common troubles will find their way into orchards of the section.

The very great distribution of the woolly aphis is no doubt due largely to the fact that it has been planted with the nursery tree. With our modern methods of inspection and fumigation the chances of living aphids being on the roots when trees are set may and should be reduced to the minimum. Preventive measures of a simple nature may mean freedom from such pests for years, and consequent healthiness of trees, while inattention to such may mean large sums of money and much time expended in spraying, etc., with the result of possible control by a diminution of the pest, but never eradication.

The inspection work to secure this freedom from insects and disease should receive the encouragement of every one interested in fruit growing, not merely because the inspector may be able to detect pests, but also because of the fact that his efforts will mean a greater effort on the part of the nurseryman, which, after all, means more than the inspection after the stock is grown. There are places, to the writer's knowledge, where inspection work is not done, which have been made dumping grounds by unreliable nurserymen for their undesirable stock.

## CHAPTER V.

## SOILS AND THEIR PREPARATION FOR PLANTING.

Apple trees require good, deep, well drained soils, preferably of a somewhat light clayey loam. No definite rule can be laid down as to the particular kind of soil for them. Many splendid orchards may be found growing on light, sandy river bottom soils, while others have done equally as well on quite heavy clay, even of the type which we speak of as adobe. Generally speaking, however, the very heavy and very light soils should be avoided. In California the brown or red mesa soils of the foothill sections along the Sierras, where they possess sufficient depth, grow fine trees. Back in the mountains proper, at high altitudes may be found a black loam, very moist and full of humus, which is admirably adapted to the growth of apples. The coast section, including Santa Cruz and Sonoma counties, has a variety of soils, ranging from light sand to stiff clay, and a number of types are known to produce excellent trees and fruit. Poor soils of any kind are not good for apples, and trees should never be set out on land which is too poor for other crops. Hardpan lands should be avoided. A layer of gypsum, marl, or heavy clay within three feet of the surface is not desirable: neither should soils be chosen where water stands within three feet of the surface at any time during the season. In such cases alkalies are very apt to become bad. While trees may grow fairly well for a number of years with hardpan or water close to the surface, sooner or later they are sure to show signs of trouble. This may manifest itself as small, yellow, sickly foliage, sparse growth, or as a mass of foliage toward tips of twigs, or some other condition indicating starvation. The healthiest trees, generally speaking, are those which root the deepest, and all conditions unfavorable to deep rooting should be avoided as much as possible.

Varieties developed to perfection on a certain type of soil would naturally be expected to do best on similar soils elsewhere. This is a phase of the question that has not been given much attention in the past, but one which no doubt will receive more consideration in the future. Prof. J. W. Nelson of the University of California, in an address before the State Fruit Growers' Convention at Davis, in June, 1914, on the "Fruit Soils of the Great Interior Valley," touched upon this subject and gave some striking illustrations of the truth that varieties do best on similar soils in different sections and made the following statement: "In our studies in this state, and elsewhere in the United States, we have observed that each kind of fruit, like other crops, has a soil and climatic environment in which it reaches its greatest perfection, and when grown on a type differing greatly from that to which the variety had adjusted its functions of growth, failure frequently results and one or more of the essential qualities is missing or is replaced by other inferior or superior ones. So if we have a desirable variety, possessing qualities which we wish to retain, we must grow the variety in a soil and climate like or nearly like those in which it obtained its

desirable qualities." This is illustrated nicely by Mr. Nelson, in the case of certain varieties of strawberries grown in Delaware, in the following words:

"Two soil types were present, namely: the Norfolk sandy loam and the Portsmouth sandy loam. The former is a well drained brown soil, moderate to low in humus, quickly warmed up in springtime, and occupies a position from one to several feet higher than the latter. The Portsmouth sandy loam is a low, damp, cool, black soil, very high in humus. The Gandy berry thrives and develops unusually desirable qualities on this soil, but becomes a miserable failure on the Norfolk soil. The Parson's Beauty, Chesapeake, and one or two other varieties reach great perfection on the well drained, warm, moderately fertile Norfolk soil, but fail on the low, damp, cool Portsmouth type.

"Farmers did not know the cause for this and kept on trying to grow the Gandy, a most attractive market variety, on the Norfolk sandy loam and thousands of dollars were lost every year for years in this attempt alone. After a careful observation of the soils present it was decided to trace out the origin of the Gandy variety and see, if possible, why it was so partial to a certain kind of soil and so sensitive to others. After some time the variety was traced to New Jersey, and it was discovered that the first seedling had originated on the same type of soil on which it was thriving in Delaware."

This striking illustration will no doubt apply to apples equally as well as to strawberries.

#### PREVIOUS CROPPING.

Many fine orchards are growing on soil which was virgin at the time they were planted. It is equally true that many failures may be traced to lack of preparation of the soil for trees. It is safe to say that cropping previous to setting trees in order to better prepare the ground is always best. There is no better crop to grow previous to planting trees than alfalfa. Our arid, western soils are usually low in nitrogen, which may be supplied in abundance by alfalfa. This crop, because of its root system, prepares the soil for tree roots better, probably, than anything else that can be grown. Trees set on alfalfa ground usually make a very quick and healthy growth. The writer has sometimes advised the cropping of land in alfalfa for a couple of years before planting apples, rather than gain two years in the growth of trees by putting out the orchard at once. The gain in time may be completely compensated for in a few years by the extra growth and productiveness of the trees following alfalfa. Other legumes, *e. g.*, peas, beans, vetches and the clovers may be used to advantage in preparing the soil for trees, but none of these possess the merits of the deeply rooted alfalfa.

#### LEVELING.

Many an orchardist has experienced much difficulty in irrigating his orchard, because of inattention to leveling the land before the trees were planted. A scraper is very often necessary for use in cutting down high places and filling in low. When the land has been made approximately level by the use of the scraper, it should be dragged or leveled by means of a common frame, field drag or some other suitable

implement made for the purpose. After the leveling is done harrowing to break up all clods should not be neglected. Moisture may be conserved much better if a fine dust mulch can be made on the surface of the soil, and a disc harrow, cultivator, common harrow or any other implement which will best make the mulch should be used. It should be remembered that a smooth surface such as might be secured by rolling the soil will lose moisture much more quickly than a surface broken up by the harrow or other cultivating tool.

#### PLOWING.

It seems hardly necessary to say that ground should always be well plowed before trees are set out, for nearly every one realizes the importance of this operation. It has already been said that a deep root system is advantageous, and for this reason, if for no other, soil should be plowed deeply to better insure such deep rooting. Not only should this deep plowing be practiced previous to setting the trees, but frequently afterwards. In general it may be said that an orchard should be plowed once a year and always to a good depth, so that the soil may be loosened sufficiently to induce deep rooting of the trees. Plowing in preparation for planting is often very carelessly done because of the fact that holes of a considerable size and depth are dug for the trees and it is not considered that careful plowing is necessary. In our arid sections where the rainfall is light—where there may be little or no water for irrigation during the dry season and as a consequence it is necessary to conserve all the moisture possible—the plowing operation should never be slighted in any way.

#### HOW TO DETERMINE NUMBERS OF TREES PER ACRE.

Any one desiring to find out how many trees can be planted per acre, at given distances apart, can do so by multiplying these distances in feet and dividing 43,560, which is the number of square feet in an acre by the product. For example, it is desired to plant an orchard on the square 30 by 30 feet; the product of these two distances is 900, and 43,560 divided by 900 equals 48, the number of trees that can be planted per acre at this distance. If the hexagonal system of planting is to be used the number may be determined by adding to this number fifteen per cent of itself. For example, 48 times .15 equals 7 plus, which added to 48 equals 55 plus. Similarly any other distances being known the number of trees per acre may be determined.

#### SYSTEMS FOR PLANTING.

The different systems for planting trees are well illustrated in the accompanying figures, numbers 20, 21, 22 and 23. There are four of them in all, and they are known as the square, triangular, quincunx and hexagonal methods. The first and last are generally used, the hexagonal having the advantage of allowing fifteen per cent more trees in a given area. A very common fault in the planting of our older apple orchards was the setting of too many trees per acre. Crowding, after a few years' growth, has as a consequence taken place, to the serious detriment of the crop and to the disadvantage of cultivation, picking and other orchard operations. Most varieties of apples should be

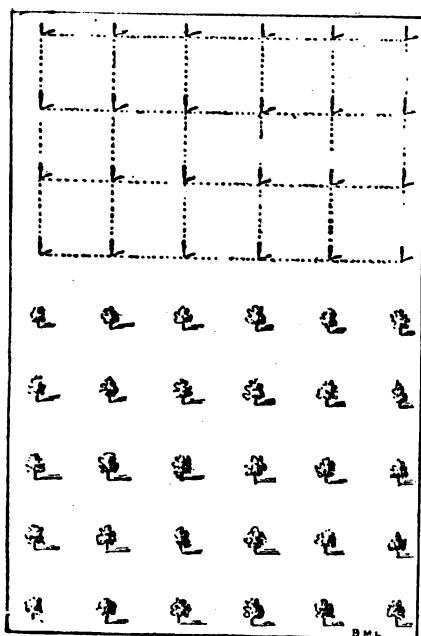


Fig. 20.—"The square system."  
(After Lelong)

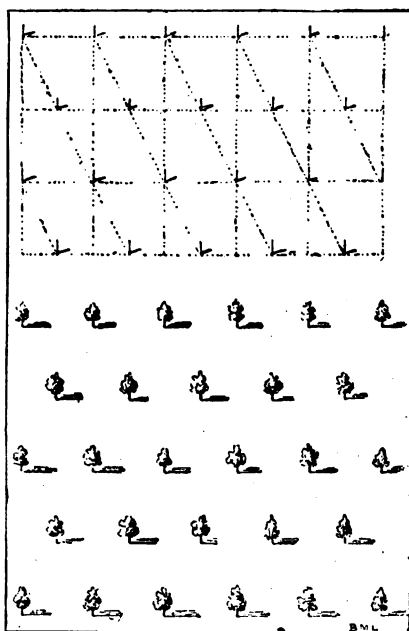


Fig. 21.—"The triangular or alternating system."  
(After Lelong)

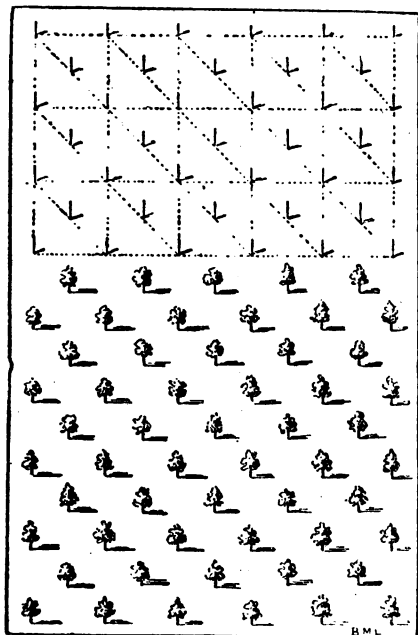


Fig. 22.—"The quincunx system."  
(After Lelong)

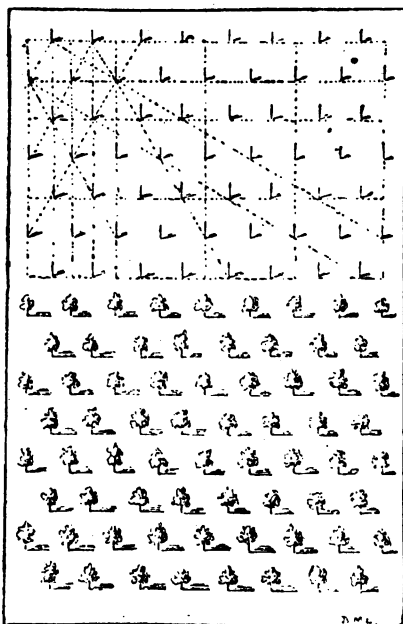


Fig. 23.—"The hexagonal system."  
(After Lelong)

planted about thirty feet apart. This distance gives ample room for all the work that must necessarily be done in the orchard, and if pruning is properly done there should never be any serious trouble from crowding. Fig. 24 is a young apple orchard at Tehachapi planted 30 x 30 square system, which has been well laid out. By setting this distance apart there would be forty-eight trees to the acre. If the hexagonal system were used there would be fifteen per cent more trees, or fifty-five to the acre, with no two trees closer together than thirty feet in this case, the distance between the rows being only twenty-six feet. This method of setting is quite popular because of the extra number of trees that can be planted without crowding. It possesses the disadvantage of leaving less room between the rows for cultivating and hauling fruit.

#### DIGGING HOLES.

Holes should be large enough so that roots may be set with their natural spread and not crowded and twisted together into a small



Fig. 24.—A young apple orchard at Tehachapi. (Original)

space. Sometimes the difficulty of digging holes is responsible for such a condition of crowding, but trees had better not be set unless the root system can have a fair show from the start. The soil at the bottom of the holes should be loosened to a considerable depth to facilitate deep rooting, and to enable the root system, which is always more or less damaged when taken from the nursery, to get a new start quickly.

It is now quite a general practice to use dynamite in loosening the soil, especially where hardpan exists. There is often much to be gained by its use, but care should be exercised to avoid packing and the consequent defeat of the object for which it was employed. Dynamiting should only be done, in heavy soils with a tendency to run together, at least, when they are dry. If moist there may be a packing or cementing, which is

decidedly bad. The post bar and shovel may do the work as well as dynamite and are safer if the soil is wet.

#### LAYING OUT LAND.

The establishment of points for the setting of trees may be conveniently done with a surveyor's level or transit. If such instruments are not available accurate results may be attained by sighting to stakes with the eye. Difficulty sometimes arises because of irregularly shaped tracts, but in such cases it is only necessary to establish straight lines as guides in laying out the main tract and filling in angular pieces afterwards. By establishing such lines a rectangular tract may be laid off, the boundaries of opposite sides being marked by stakes of a convenient size and color so that they may be easily seen, and defining accurately the distance between the trees or rows. A line of stakes set the same distance apart should be run parallel to one of these boundary lines somewhere near the middle of the field. These three being determined, points in between to locate position of trees can be accurately placed also, and by sighting in two directions at right angles to each other, there should be little chance of serious errors in alignment. If, instead of the square method of planting, the hexagonal is to be used, it would be necessary to establish twice as many points on the boundary and in the line parallel to same to determine the position of the trees in alternate rows.



## CHAPTER VI.

## SETTING AND CARING FOR THE YOUNG TREES.

The tract of land to be planted being laid out with stakes to mark the position of each tree, it is next necessary to have some way of determining the position of a tree where the stake stood after its

removal in the digging of the hole. A simple but satisfactory apparatus for doing this is shown in Fig. 25.

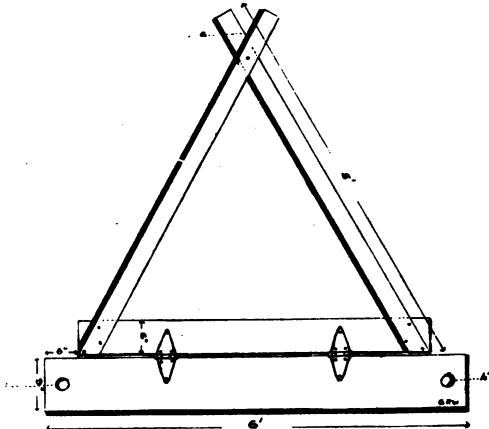


Fig. 25.—A simple apparatus used in setting trees. (Original)

This is placed against the stake at the point *a*, pins are then driven through the holes at *h* and *h'*, thus securely fastening the frame to the ground. The portion in front of hinges is now thrown back and the hole dug. Afterwards the front and main portion of the frame is again moved forward over the hole and the tree placed in the crotch at point *a*,

which corresponds exactly to the place where stake originally stood. With such an apparatus great accuracy may be attained. The hinges shown in figure are not a necessity as such an apparatus may be made without, but is less convenient as it must be removed from stakes entirely, while holes are being dug. A straight piece of board with notch in center and holes or notches at each end for the stakes is frequently used.

## DEPTH TO PLANT.

The rule is to plant trees in the orchard slightly deeper than they grew in the nursery, or in other words, the bud union should be at the surface of the ground when the tree is set. The depth of planting may be varied slightly without any apparent detriment to the growth of the trees, but all things being considered there is probably no better depth than is indicated by the bud union at the ground line, and care must be taken not to plant too deep as such may result in the death of the trees.

## FILLING IN THE HOLE.

The tree being placed in the hole at the proper depth, and the roots being spread naturally, the soil is now carefully packed about them. The entire space about the crown should be closely filled with soil, and the careful planter will use his hands in doing this work. After the roots have been properly cared for, the shovel is used to fill in the

rest of the hole. It is always well to pour a bucket of water into the hole before it has been entirely filled, so that the tree may have plenty of moisture and also that the soil may be better packed about the roots. After watering, the hole should be filled in completely.

#### **IRRIGATING THE YOUNG ORCHARD.**

The first one or two irrigations after planting may be done in furrows made previously, and in which trees have been set. While this method insures an abundance of water at the start, it may result in damage because of the baking of the soil about the trees and should not be continued for any length of time after the trees are set. It is much better as a general rule to irrigate by means of smaller furrows on either side of the rows, containing small heads of water run long enough to thoroughly saturate the soil surrounding the trees. The tendency to bake will not be nearly so great as when the ground is actually flooded. As soon as possible after irrigation, the cultivator, spring tooth harrow, disc harrow, or other suitable implement should be used, so that the moisture may be better conserved and so that all tendency of the soil toward baking, may be eliminated. In sections where irrigation is not practiced the cultivation recommended to follow irrigation, should be conscientiously done to conserve the moisture so necessary for the proper growth and development of the trees.

#### **PROTECTORS FOR YOUNG TREES.**

Young trees are always liable to attack by rabbits and other rodents, and are also subject to sun scald during the summer season. As a protection against both the rodents and sun scald various shields are placed about the trunks. Sometimes a cylinder of heavy paper is used, sometimes wire screening, probably best of all are wooden protectors made very thin from some pliable wood. These should be left the natural color and never painted black as sun scald may be worse if black protectors are used than with none at all. A common lime whitewash is a splendid sun scald preventive.

## CHAPTER VII.

## PRUNING.

## CUTTING BACK THE YOUNG TREE WHEN SET.

It has already been said that a one-year-old whip is the best tree to plant. Such should be cut back when planted, because of the damage which has resulted to the root system in digging and the consequent disturbance of the balance between root system and top. The root hairs, the function of which is to take up the plant food in solution from the soil, have been practically all destroyed, and new ones must be formed before the tree can be supplied by the roots. It is consequently dependent, in starting at first, principally upon the stored-up plant food in the top and must grow for a short time, at least, almost independently of root action. This being the case, the less top that there is the better chance will the root system have to make a rapid recovery and renewal of root hairs. The height at which this one-year-old tree should be left will depend upon the distance from the ground that it is desired to make the head. The tendency now is to head trees as low as possible, and still not interfere with cultivation of the orchard. The writer can see no good reason for heading apple trees more than twenty inches above the surface of the ground. This gives enough trunk for a beautiful, shapely tree, and if later pruning is properly done there will be no trouble about cultivation. As the first pruning may largely determine the height of head, a short discussion on the advantages of a low-headed tree will not be out of place here.

## LOW HEADING.

In California, as well as practically every place where apples are grown, there are times when the sun is very hot and sun scald of the bark may take place to the great detriment of the trees. Such injury makes a favorite place for the flat-headed or so-called sun-borers to gain entrance and do their work of destruction. Knowing this, is there any good reason for leaving a great high trunk, very often unprotected in any way, exposed to the action of the sun? The destruction wrought by sun scald and its attendant borers in California is so great that low heading of trees can not be too strongly recommended.

Most of our orchards are set out for commercial purposes and it is expected that the income from them will be a good one. As in every other business, it is necessary to keep down expenses to the minimum in order to make good profits. The cost of picking fruit is greatly increased when it is necessary to climb tall ladders to get it.

A certain height of head having been decided upon at planting time,—we will say twenty inches for the purpose of illustration, as well as

because it is believed that this is about the right height—it is obvious that all branches which form the scaffold or framework of the tree,

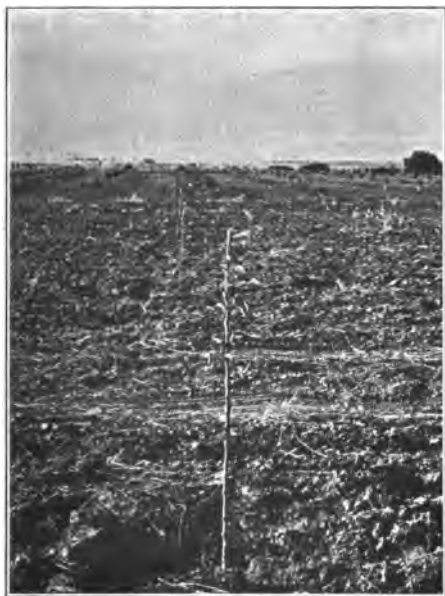


Fig. 26.—A tree cut back to thirty inches in height when set. (Original)

should not emanate from about the same point in the trunk, because of crowding and consequent weakening of the framework. There should be at least from ten inches to one foot allowed for spacing these branches for the very best results. If then we desire to have our apple trees headed within twenty inches of the ground the newly set tree should be cut back to a height of thirty or thirty-two inches. The current season's growth will be in the form of many laterals from this thirty inches or more of trunk, and if everything is favorable they should develop almost throughout its entire length. See Fig. 26. The practice of rubbing off shoots low down on the trunk is very often followed during the first summer. It is

doubtful if it pays to do this as the tree needs lots of foliage for its best development, and the chances of sun scald and its attendant evils are also increased by this practice. Moderate summer pruning may, however, be done, and the second season there should be plenty of branches to choose from in forming the framework.

#### SELECTING THE FRAMEWORK BRANCHES THE SECOND SEASON.

Only a glance is necessary in practically any of the older orchards, when it will be seen that very little attention has been paid in the past to the careful selection of a proper number of branches rightly spaced. Such trees as the one shown in Figs. 27 and 28 are not at all uncommon. This type of head is decidedly bad and has no place in the recently planted orchards. A great number of weak crotches are inevitable in such cases as this; no larger head can be formed than on a lesser number, and it will not be nearly so thrifty, but worst of all, the time will surely come when, because of accident or otherwise, it will be necessary to prune out some of the large limbs from the framework. The close quarters for pruning will not permit of doing the same with ease, and as a consequence large stubs will be left which always mean disaster to an apple tree. The ends will not heal over, rot fungi will get in their work, borers and termites find conditions favorable, and what might have been a long-lived tree is doomed after only a few short years of productivity.



Fig. 27.—An apple tree started with too many framework branches. (Original)



Fig. 28.—The same tree as the one shown in Fig. 27, illustrating the willow-like growth of the top. (Original)

From three to five branches are plenty, when carefully selected in regard to spacing and balancing the head, for any apple tree. Many prefer three because of the fact that just as large a head can be formed upon them as on five, and there will not be so much chance for crowding. Again, the lesser number is desirable because of the extra size they will attain and the consequent ability to hold up greater loads of fruit. Occasionally four or five are left rather than three because of the liability of breaking off branches in cultivating, etc. If one out of three scaffold branches is broken the head is very apt to be unbalanced and difficulty may be experienced in getting it shaped up well afterward, where if there were four or five and one should get broken the chances would be more favorable.



Fig. 29.—Old apple orchard started with only three scaffold branches. (Original)

Fig. 29 shows one of the oldest orchards the writer has seen, which was started with three scaffold branches. While the spacing of these was faulty in this case, the trees are much better than they would have been had more branches been left. Fig. 30 shows an apple tree after the second year's pruning, which has been well headed and which has only three branches left to form the framework. Fig. 31 shows another well-headed tree of the same age, in which five have been left instead of three. Either tree will make a good growth, but the former will develop the stockiest branches and should be a little better tree at the end of the growing season. The branches selected for the framework should not be left in their entirety, but should be cut back as shown in Figs. 30 and 31. If they are left without cutting back, slender willowy growths will probably be the result. If cut back to lengths of twelve to fourteen inches a heavier growth and a greater increase in the

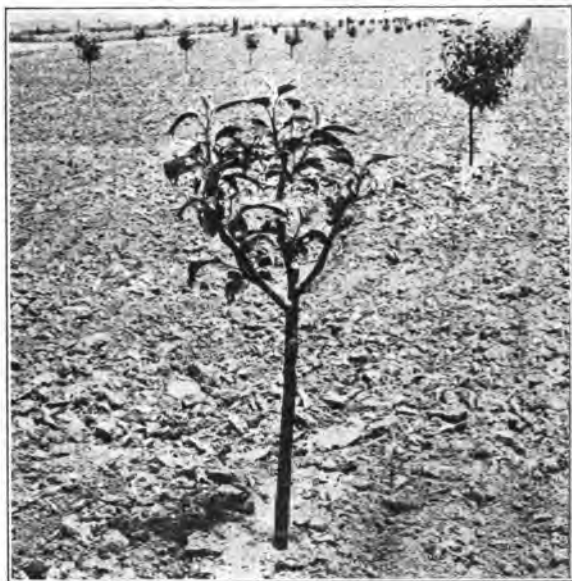


Fig. 30.—Young apple tree after the second season's pruning, showing a head started with three scaffold branches. (Original)



Fig. 31.—Young apple tree after the second season's pruning, showing a head started with five scaffold branches. (Original)



Fig. 32.—Young Winesap tree in foreground which has been heavily pruned, photographed at beginning of third season.



Fig. 33.—Same tree shown in Fig. 32, after season's growth.



diameter of the twigs will take place. The value of this heavy cutting back is well illustrated in Figs. 32 and 33 which show the same tree. The first picture was taken early in the spring and the second on September 21st.

In the case of most varieties of trees, at least, it is best to cut to outside buds when the second season's pruning is done, in order to spread the head. The amount of spread will, however, depend largely on the variety, and whether outside or inside buds are left at the terminals of the twigs will depend upon this varietal factor. For instance, the Winesap has a great tendency to spread and grow bushy, and in order to make it grow upright, or at least to increase that tendency, cutting should be done just above an inside bud. On the other hand,



Fig. 33a.—Same tree shown in Fig. 33, after being pruned.

the Rome Beauty tree has a habit of growing upright, similar to the Bartlett pear, and by cutting branches in each case just above outside buds the tendency will be for the branches to grow outwardly and thus spread the head. More attention to this particular phase of the pruning operation will be necessary during successive seasons than during the second.

The desired number of branches having been selected and cut back as shown in the figures, the tree is now ready for the third season's growth.

#### PRUNING THE THIRD SEASON.

Fig. 34 shows the ideal type of head after the third season's pruning, when three scaffold branches have been used in forming the framework. It will be noticed that on each one of these have been left three of the season's branches, selected so as to avoid bad crotches, properly spaced and cut back just as was the previous season's growth. Thus we have a tree with a trunk which has had three years' growth. From

this trunk are three branches which have had two years' growth, and in turn each one of these supports three main branches with a few laterals or fifteen for the entire tree, which have had only one year's growth. If instead of the five scaffold branch tree we develop a head with three there would be only nine of the one year old branches left, which, however, is enough with the laterals that they in turn will throw out to make a big tree, capable of bearing just as much fruit as the former, and having the advantage usually of extra strength of branches.

A slight modification of the system recommended for the first three years is used in heading the young Gravenstein trees in the Sebastopol



Fig. 34.—A young apple tree, well headed, after the third season's pruning.  
(Original.)

section. This tree makes a splendid growth under the conditions existing in that section, and in order to prevent crowding in the head, to render cultivation easy close to the trees, and to develop strong branches, three are left during the second season and cut back as already suggested. Only one branch is allowed to develop on each of the three limbs of the second season's growth, and is cut back the third season, so that the tree still has only three main branches, but each one cut back so that the height of the head is increased by only a couple of feet. Fig. 35 shows a young Gravenstein tree at Sebastopol with three selected branches cut back to 7 inches the beginning of the second season and allowed to develop additional length the third. The fourth season two or three branches are selected on each one of these. In this manner a little higher branching head is developed, but one which is very strong (see Fig. 36), due to the growth being thrown into only three branches, well cut back for two seasons after planting.

**PRUNING THE FOURTH AND FIFTH SEASONS.**

At the end of the third season a shapely head should be formed and such a framework for the future tree developed, that pruning ought not to be a difficult matter. Too often do we find orchardists neglecting the work after this time. The first three seasons while trees are small the task is neither expensive nor difficult, but as they grow there is a rapid increase of both expense and difficulty of pruning in general, and the tendency is to be rather careless afterwards. It must be re-



Fig. 35.—A young Gravenstein tree after the third season's pruning, shaped after the methods used in the Sebastopol section. (Photograph by O. E. Bremner)

membered, however, that pruning for the best results must not be neglected for a single season. Careful, annual pruning, beginning the first season when the trees are set and continued until they no longer bear crops, will do more toward making a success of the apple business than practically everything else. Neglect for one or more seasons, followed by very heavy pruning as a result, is not conducive to regular bearing of the trees, nor to successful apple culture.

During the fourth and fifth seasons the trees will bear a little, but should not be allowed to overload themselves. The orchardist should still devote his energies toward growing trees and not fruit. All inter-

fering branches should be removed. The balance of the head should be preserved and at least a moderate amount of cutting back of branches should be done. Care in cutting to outside buds during the cutting back process will have a tendency to spread the trees if such is desirable, or the reverse operation may be found necessary. Fruit spurs will have developed by the fifth season and care should be exercised to preserve these on the trunks and larger limbs, where they are so often



Fig. 36.—A tree with a very strong framework developed by heavy cutting back.  
(Photograph by O. E. Bremner)

cut off by pruners. One of the mistakes most commonly made in pruning apple orchards is the cutting away of these spurs. Unintelligent pruners will almost always begin cutting from the ground and the removal of these valuable spurs is the result. Orchardists should insist that pruning be done very largely from a ladder, as the tops of the trees need a good share of the attention in this work. In fact, if heading has been well done there should be practically no cutting from the ground, except possibly of a few succulent sprouts.

### PRUNING MATURE TREES.

Correct heading and careful annual pruning of the apple tree for the first five years simplifies the pruning operation for the years to follow. Except in cases of accident to trees there should be no large branches to take out. The work thus far should have been done with the idea of leaving just enough large branches to form the best possible head without any interference or crowding. Just as soon as such takes place in later years all branches that have a tendency to interfere with others should be taken out before they attain a large size. More



Fig. 37.—A tree of the Yellow Newtown variety, showing the development of fruit spurs from water sprouts, due to summer pruning. (Original)

or less cutting back will be necessary each season, and a study may be made of the habits of growth of different varieties and cutting to outside buds or branches, or the opposite may be practiced according to the needs of the variety. In most cases fruit spurs should be preserved and it may even be necessary to encourage their development.

Mr. W. S. Ballard of the Bureau of Plant Industry, U. S. Department of Agriculture, and Mr. W. H. Volek, County Horticultural Commissioner of Santa Cruz County, have been carrying on some very interesting experiments for the past few years to determine the feasibility of developing fruiting spurs from the so-called water sprout growth that always develops more or less in every orchard. They found that by cutting back such sprouts early in the summer season,

leaving two or three inches at first and cutting the new growth back two or three times later in the season, so that by the end of the growing period there would be formed a growth about six inches long, a fruit spur that would bear excellent fruit the following season could be developed. Fig. 37 shows one of the trees in the experimental orchard near Watsonville. Similar results may be attained by cutting back these sprouts during the dormant season, but it may take several years to form healthy, vigorous fruit spurs. By the summer pruning method only one season is necessary. Not only are the water sprouts



Fig. 38.—Branch well studded with apples, close to the main limb and not in danger of wind damage. (Original)

cut back but also new growth throughout the entire head of the trees. Thus fruit spurs are formed close to the larger limbs and as a result apples are produced close in as shown in Fig. 38.

The results of the experimental work done by Messrs. Ballard and Volck mean much to orchardists who have allowed the destruction by pruning of fruit spurs low down on their trees. Heavy cutting back from the top will generally induce much of the so-called water sprout growth low down, which may be utilized in the development of spurs. Not only the water sprouts low down on the trunk may be made over into fruit bearing wood, but new growth anywhere on the tree may be handled in the same manner with the consequent development of fruit spurs. In places where trees have a tendency to bear light loads of fruit this method of summer pruning, whereby all rank growth is checked and the development of fruit spurs encouraged, can be used to very great advantage.

#### NATURAL BRACING.

When a tree has not been well headed or well pruned it is sometimes desirable to brace the branches against possible injury. This is done by twisting together two young twigs, when a union between the two will take place, forming such a brace as shown in Fig. 39.

**STUBS.**

Notwithstanding the fact that the practice of leaving stubs in an orchard when pruning, has been condemned by expert horticulturists in practically every publication on pruning, there are still a great many trees to be seen in some of our otherwise splendid orchards, with these unsightly and dangerous stubs, bearing testimony to the fact that pruners either did not understand their business or did not care how the work was done.

Branches should always be cut off close to other branches or trunks from which they emanate, in which case healing will take place and the wounds will in time be covered over with new bark, provided that rot



Fig. 39.—Natural braces used to strengthen branches. (Original)

fungi, with their attendant decay, do not develop. If stubs of any size are left on apple trees, they always die back to the point where the cut should have been made and very frequently dying does not stop at this point, but the trunk or larger limbs are also involved.

The reason for this dying back is very clear, when we consider how the tree gets its supply of plant food that enters into its growth. As every orchardist knows, this food is taken from the ground in solution in the water of the soil, and is carried upward through the sap-wood to the leaves. There, through a complex process it is elaborated or converted into starch and sugar and becomes available food, which then journeys downward through the cambium or growing layer of the bark. It is then capable of healing wounds and entering into the life of trees. Before going to the leaves in its crude form there could be no healing. Knowing this it can easily be seen why dying back takes place in the stubs that are left by careless or thoughtless pruners. The apple tree

is not quick to develop buds and throw out new growth from a cut off branch, hence we have a stub without any foliage to manufacture the plant food from the crude material taken up by the roots, and while the sap may journey upward for a time through such stubs, there is no downward flow of elaborated sap from the leaves and consequently no healing. Rot fungi get in their work soon afterwards, drying out takes place, and a tree may be ruined in a very short time. Many an orchard in California has either died outright or become worthless because of the careless leaving of stubs.

#### TREATMENT OF WOUNDS.

Since drying out over the cut surface takes place very rapidly after a branch has been removed, it has been the practice to paint over wounds to prevent this drying, thus giving the healing process a better chance to operate. It is probable that the idea of painting has been carried to the extreme and too much dependence has been placed upon it. A branch can not heal, as has already been pointed out, unless the cut has been properly made. There has been a tendency among some orchardists to cut without any care whatever, and then paint heavily,

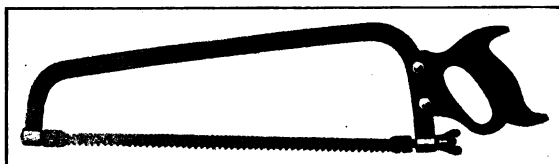


Fig. 40.—A good type of pruning saw.

expecting the treatment to work the miracle of healing against nature's way. It probably does not pay at all to treat small cuts, and unless the branch removed is three inches in diameter or more, the time and labor spent in painting would probably be lost.

When treatment of wounds is thought to be necessary there is nothing better to use than a common lead paint. Certain grades of asphaltum have also been used with success.

#### PRUNING TOOLS.

Much time is often wasted and sometimes damage done to trees because of the use of poor tools. Practically all the pruning work about



Fig. 41.—A good type of pruning shears.

an orchard can be done with the saw shown in Fig 40 and shears in Fig. 41. The former has a blade which can be inclined at any angle, so that it is possible to cut in almost any kind of a crotch. The blades, when broken, can be easily removed and replaced at small cost,



## CHAPTER VIII.

## TOP-WORKING APPLE TREES.

It frequently happens that varieties of trees are found, when they come into bearing, to be different from those that were ordered; again, varieties may have been poorly chosen and found to be unadapted to the conditions where they are set out. In either case grafting over to some other variety may be necessary.

In the case of two or three year old trees this process is very simple and may be done without any appreciable injury to the trees. Such young trees as these can be very easily budded by inserting buds of the desired variety into small branches low down. Several branches can be selected because of their placement being such as to be desirable in the formation of the head. The best time is in August or September. The following spring, if the buds are found to be green, indicating that they have united with the bark of the tree, branches should be cut away just above, thus throwing the strength of the tree into the buds, when they should make a very rapid growth. If trees have large tops it may not be well to cut them all away at once, but to leave a portion of them until the buds have made a good start, when the entire tops can be removed.

If grafting is preferred to budding, larger limbs may be chosen. In fact, if the tree is only two years old it may be successfully grafted by cutting it back below the branches and inserting one or two scions, according to the size of the trunk. There are several methods of grafting, the two most common being known as kerf and cleft grafting. The first consists of the insertion of a scion in a V-shaped opening made in side of limb, the scion being shaped to fit tightly into this opening, where it is immediately covered with wax. Cleft grafting consists in the splitting of the ends of the sawed-off limbs and the insertion of scions previously cut at one end, so that the cambium layer may be brought into contact with the corresponding layer of the limb being grafted. Whether cleft or kerf grafting is done the scions should be sloped a little outward, so that the cambium layers will cross, otherwise there may be no point of contact between the two and as a consequence no union. Crossing is all that is necessary to insure a good union. Waxing to exclude the air should be carefully done.

The scion should be made from one year old wood with well formed, thrifty buds taken from a good producing tree. Succulent water sprout growth is not desirable for scion wood. Two or three buds are sufficient to leave on each scion and the ends, if cut, should be waxed over.

What has been said in regard to grafting young trees will apply to old also, but very large limbs should not be chosen for grafting. Budding may be successfully done in young growth low down on older trees. If limbs two inches in diameter or more are cut off for the insertion of scions more than one should be put in a stub. In the case of very large limbs, several must be inserted if the healing of the cut surface takes place entirely around the stub. A scion should not be expected to heal for more than an inch and one half or two inches on

each side, and enough must be used to heal the stub entirely around, or else drying out and the death of parts not fed by the downward flow of sap from the leaves of the scion will take place, weakening, if not eventually killing, the stub and its graft.

Many experienced grafters prefer to leave a considerable portion of the top of old trees for one or two seasons after grafting. This is undoubtedly a good practice, but such should not be left long enough to interfere with the growth of the grafts.

Aphis are very often exceedingly destructive to young grafts and care should be taken to control them by means of sprays before they bring about permanent injury.

#### GRAFTING WAXES.

A good grafting wax being one of the requisites for successful grafting, the following, copied from "Fruit Growing in Arid Regions," by Paddock and Whipple, is given :

" \* \* \* There are the waxes applied warm with a brush and those applied cold, the heat of the hands being sufficient to make them pliable. With the first it is necessary to have special equipment to keep the wax melted in the field, and this generally limits its use to a few professional grafters who are prepared to use it. The cold waxes are prepared for use by melting together the ingredients, pouring the melted material in cold water, and pulling it like taffy until it becomes a buff color. It can be kept from season to season by immersing it in water. The common formula given for the preparation of this wax is four pounds of resin, two pounds of beeswax, and one pound of tallow. Paraffin may be substituted for the beeswax in this formula ; although it seems that the resulting wax is hardly as durable, it serves the purpose very well. By increasing the amount of resin in the above formula to six pounds, it makes a very good hard wax for warm application. Another good wax to be applied warm is prepared by melting together three pounds of resin, one pound of beeswax and one pint of raw linseed oil."

## CHAPTER IX.

## INTERCROPPING.

During the five years or more while the young apple orchard is coming into bearing it is often quite a problem for the man of limited means to make a living, and he must either secure work elsewhere or grow crops between the trees, out of which he can make a sufficient sum to keep up expenses until a profit can be made from the apples.

Cropping of land between orchard trees, even while young, has sometimes been discouraged, but the writer can see no good reason why such should not be done even after trees come into bearing, provided that certain precautions are exercised. The orchard should of course receive first consideration and no crops of any kind should be grown between the tree rows, which in their care would detract from the care of the trees. In this connection it is unwise to grow crops that require water late in the summer or in early fall, as irrigation at that time may start new growth or keep trees growing too long into the winter, in either case rendering them liable to injury during the winter months, because of the soft unripened condition of the wood.

It may happen that there is scarcity of irrigation water for the orchard. In such case it would also be unwise to plant intercrops of any kind and thus take away the moisture needed by the trees.

Crops such as corn, which make a rank growth, might not be best for very young trees, on account of shading them too much.

Notwithstanding these objections that may be cited against an intercrop in the young orchard, conditions are very often such that with the proper crops and the proper care there will be no harm done, and much good may even result to the orchard because of better care due to these crops.

As was mentioned in another chapter, California soils are usually deficient in nitrogen and any leguminous crop is good to grow between the trees, because of its adding this important element to the soil. Peas and beans for this reason are excellent as intercrops, and provided that market facilities for such are good there is probably nothing better that can be grown. Of the non-leguminous crops may be mentioned potatoes, cantaloupes, strawberries, cabbages, celery, in fact almost any vegetable crop, and the one chosen will depend in most cases upon the demand for the product.

Field corn is quite frequently used as an intercrop, but is probably not the best crop for the first year, at least. Its tendency to grow very tall if it does well is against it, for the young trees are very often shaded too much, and as a consequence fail to make the growth that they should. This objection may be partly eliminated by keeping the rows of corn several feet away from rows of trees, thus giving the latter more room. Sweet corn and popcorn, because of their smaller growth and lesser amount of shade, could be grown with less danger of damage than the field corn.

The growing of intercrops is very often discouraged because of the plant food that is taken from the soil, thus depriving the trees of their supply. This objection is certainly weak, for no one should expect to grow orchard trees on land for many years without fertilizing to supply the elements removed, and the growing of crops between the trees merely hastens the time when such fertilization must be done.

## CHAPTER X.

## IRRIGATION, CULTIVATION—COVER CROPS AND FERTILIZERS.

The scarcity of water in some parts of the state where apples are grown, and the total absence of rain during the summer season, makes the conservation of moisture in the soil one of the important orchard problems. Fortunately, the rainfall during the winter is ordinarily quite heavy and the ground receives a good soaking during that season. If nothing is done to check the evaporation of moisture after the rains cease and the hot weather comes on, the soil may become too dry in a very short time. Those who are fortunate enough to have a good supply of irrigation water are inclined to use it freely, thus keeping the orchard



Fig. 42.—Well tilled orchard in Humboldt County.

in a moist condition without any attempt to conserve what is added. Very frequently, it may be said, too much water is used for the good of the orchard, which would be better off if less were applied and the cultivator used more. The best condition of the soil occurs not when it is excessively wet, but when it is quite moist and the surface not baked but in a loose, workable condition. Aeration is just as necessary for the best development of the root system as moisture, and an excessive quantity of the latter may cut off the air supply to such an extent as to interfere materially with the growth of the trees.

It is sometimes difficult to make people believe that cultivation does actually conserve the moisture, but a trial only is sufficient to convince the most skeptical. The reason that it does lies in the fact that the

capillary action, by means of which the soil water is brought to the surface and there evaporated, is checked. In other words, the soil is made up of fine particles with spaces in between which become filled with water. As a liquid in a fine tube will always travel upwards and reach a level much higher than outside the tube, so in the soil we find the same tendency, and we may conceive of the water as coming up through myriads of little tubes which remain wide open to the surface unless something is done to interfere with their continuity. Such interference may be brought about by the use of the cultivator during the summer season, when evaporation takes place so rapidly under ordinary conditions; but, as they will soon open up again after disturbance by the cultivator, frequent cultivations are necessary, so that as fast as the mois-



Fig. 43.—Well tilled orchard in Santa Cruz County. (Original)

ture finds its way to the surface through these tubes, it is checked by again breaking the capillarity. Figs. 42 and 43 show two well tilled orchards in Humboldt and Santa Cruz counties. The ideal condition of the soil to prevent evaporation is that of a dust mulch, which may be maintained by working the soil with some type of harrow or cultivator once a week. Some enthusiastic advocates of clean cultivation have gone over their orchards even more frequently than this.

Besides being a valuable means whereby moisture may be conserved, cultivation is beneficial in keeping down weeds, and also places the soil in the best possible condition for root development and the resultant tree growth. It is a matter of common observation that orchards to

which frequent summer cultivations are given make better growth than do those where cultivation is neglected. In most parts of the arid West, but not commonly in California, we find conditions that do not favor summer cultivation. The winters in these places are so cold that nothing can be grown during that season of the year. Consequently there is no time, if clean cultivation is practiced, when a crop can be grown for the addition of nitrogen or humus, hence the necessity of growing a summer cover crop.

#### COVER CROPS.

In most parts of California our fine warm winter climate enables us to grow crops of some kind in the orchard during this season. Owing to this fact summer cultivation is advocated and is practiced successfully nearly everywhere that apples are grown. Because our soils are deficient in nitrogen, a leguminous cover crop is preferable. Among the legumes which have given good satisfaction under our conditions may be mentioned the common burr clover, vetches, peas, sweet clover and alfalfa. Many object to the growing of alfalfa in an apple orchard, and probably it is not good practice to sow it unless it is done with the idea of using it for a cover crop only and not for hay. On hardpan soils there is nothing better than the root system of the alfalfa to penetrate into this hard layer, thus breaking it up more or less and enabling the apple roots to go down deeper. When used for this purpose it should of course be left growing in the orchard more than one season. When alfalfa is sown it should be kept some distance from the trees in order to facilitate plowing later on, and is only desirable where plenty of water is available for irrigation. Generally speaking, the cover crop should be grown only during the winter season, being plowed under early in the spring, if possible, before the rains have ceased. Frequent cultivations later on, after the season becomes warm, will result in conservation of the moisture. If it is not possible to grow a leguminous cover crop, an annual crop such as rye, wheat or barley may be grown. In this case the principal value would be to better the physical condition of the soil, together with the addition of humus. There are places in the state, no doubt, where apples are grown, and where the rainfall is insufficient to make a cover crop practical, even during the winter season. In such cases fertilizing must be done in some other way.

One of the most successful apple growers of the East says that he made his orchard practically an annual bearer by the use of cover crops.

#### FERTILIZERS.

There is nothing better for the orchard than barnyard manure, and while the supply is often limited it is in other cases wasted when it might be used to good advantage. It is always wise to apply this liberally, unless the cost is such as to make it prohibitive.

Commercial fertilizers have not been used extensively, but no doubt would give results under certain conditions at least. Spraying with nitrate of soda and other nitrates, in the early spring, has been done

in an experimental way by W. H. Volck at Watsonville. The results that he has attained have on the whole been excellent, and this method of applying nitrates bids fair to come into general use.

Many of our California soils are deficient in lime and the addition of either air slaked or ground stone lime might be beneficial. No rules can be laid down for this work because of the great varieties of soil that occur in the state. If trees are not doing well it may be that fertilizers of some kind are needed. A soil analysis will serve as a guide as to what should be added, but must not be depended upon too much, for while it shows what elements of plant food the soil contains, and the proportions of each present, it does not show how much of each is available, so after all much experimental work is necessary.

As stated previously, nitrates are nearly always scarce and fertilization usually means the addition of the element nitrogen, either in the form of leguminous cover crops grown in the soil, or mineral nitrates applied direct or in the form of a spray to the trees.

## CHAPTER XI.

## THINNING.

One important operation in connection with the handling of our immature apple crop, viz, thinning, is too often neglected. The excuse generally given for not thinning is that it costs too much. This is a case, however, where a little extra money invested will add greatly to the income of an orchard. There are records of a number of experiments that have been carried out which prove conclusively that thinning pays, and to neglect the operation means to fail to do one of the most important things in connection with the growing of apples.

## INFLUENCE UPON THE FRUIT.

It is the desire of every fruit grower to produce fruit possessing a good size, high color, fine quality and uniformity. Such is usually impossible unless thinning is practiced.

The size that fruit attains—not taking into consideration the variation due to variety—is influenced more or less by age of trees, stock, soil, climate, cultural methods and the presence of disease or insect pests. Some of these influences may be such as to prevent the production of a desirable size of fruit, but in general our trees will with ordinary care produce fruit of good size, provided that they are not overloaded. The time has passed when we want to place a premium on abnormally large fruit. It is not the purpose to advocate thinning so heavily as to bring about an overgrown condition, but during seasons of big crops to thin to a point where the most desirable size for the variety can be attained. Any one who is at all familiar with the orchard business knows that great losses are often occasioned because of undersized apples.

The desirability of producing good color is unquestioned. Not only does this please the eye but also adds to the quality. A rosy red Winesap or Baldwin apple will be sweet and juicy, with a flavor to suit the most delicate palate, while the same varieties grown on the same trees, but uncolored, will be scarcely relished. Leaving out of consideration the fact that color influences quality in the variety, the beautiful red apple will command higher prices on the market than better varieties without color.

While size, color and quality must all be taken into consideration, there is probably nothing more desirable than uniformity, and in no way can this condition be brought about better than by thinning; in fact, it is impossible during seasons of large crops, at least, to secure uniformity in size in any other way. The greatest argument in favor of thinning, as far as the fruit alone is concerned, is based on the above statement. A lack of uniformity complicates standardization methods and all the operations of packing, and is not at all desirable in the canning and drying business. If by thinning, fruit can be made to average well in size, a considerable outlay of money is justifiable for the operation.

Another argument in favor of thinning has to do with the presence of the worst insect pest of this fruit, viz, the codling moth.



If apples are allowed to grow in clusters so that they are touching one another the larvæ not only take advantage of the ideal point of entry between the apples, but the sprayer is placed at a decided disadvantage, for he finds it extremely difficult to get the spray where it will be eaten by the worms. Varieties that have a tendency to cluster are nearly always riddled by codling moth if the pest is present in large numbers, unless the clusters are broken up by thinning.

#### INFLUENCE OF THINNING UPON TREES.

As far as the trees themselves are concerned there are three main reasons why thinning should be practiced: first, it allows them to make a proper growth; secondly, it prevents breakage of limbs, and thirdly, it induces uniform annual crops.

A tree is capable of taking just so much plant food in the way of nitrogen, potash, phosphoric acid, etc., from the soil through its roots, and carbon from the air through its leaves. An excessive amount of fruit is apt to require most of this food at the expense of a good thrifty growth. The desire of most orchardists is to develop a tree to bearing size in the shortest possible time, and to have it bear abundant crops each season, often depriving it of proper growth in so doing. Our trees, I fear, are too often worked to death, and we wonder why in a few years' time they begin to deteriorate and the crops of former years are not harvested. The splendid deep soils so full of plant foods that we find so commonly in our state, will do much towards bringing about the heavy annual bearing so greatly desired, but no soil will last forever, and the time will come when trees, or whatever else may be grown on land for year after year, will develop large crops only at the expense of growth and health, unless something is done in the way of fertilizing to build up the soil and thinning to prevent over-bearing.

Thinning to prevent branches from breaking down under their weight of fruit is quite generally practiced, but too frequently do we find the prop doing this duty. A heavy crop of apples is usually followed by a light one. This is undoubtedly due to the fact that the trees are allowed to bear too heavily during seasons of good crops, consequently the formation of fruit buds for the next season's crop is prevented. A tree not only has to mature its crop of fruit and make a certain amount of growth during a season, but it also has to make fruit buds for the succeeding season, a process which is frequently rendered impossible by overproduction.

#### THINNING BY PRUNING.

The cutting out of wood containing fruit buds during the dormant season may be done as the first step in thinning the crop. Pruning, when done with the idea of thinning the fruit, must be done intelligently and not by men whose only knowledge of the business consists in their ability to cut off a branch because they think it interferes with the proper shape of the tree. Because of no knowledge of the bearing habits of an apple tree we sometimes see trees from which all the fruit spurs have been cut as high above the ground as a man can reach. These are exaggerated cases, but serve to illustrate the fact that too little attention is paid to some of these fundamental principles which bear upon the subject of thinning.

Pruning can not be made to take the place of thinning altogether. Fruit will cluster just the same on pruned trees as those unpruned, and there is no way of breaking up these clusters and giving each fruit room for development, except by picking off part of it by hand.

#### THINNING BY REMOVING THE FRUIT AFTER IT SETS.

The earlier the fruit is removed the better chance will the remainder have to develop. While no time can be set, that will not be subject to wide variation with seasons and different fruits, in general thinning should be done just as soon as possible after the fruit sets and danger of the early, or so-called June drop, is over. The work may be done quite handily with a pair of thinning shears such as shown in Fig. 44. These may be purchased at small cost and will greatly aid in the work.



Fig. 44.—A good type of shears for use in thinning apples.

The amount of fruit that should be left on a tree is, of course, an exceedingly hard thing to judge. Some have advocated thinning with the idea of leaving a certain number of boxes of well developed fruit. While this might not be done with a very great degree of accuracy at first, those who have tried it claim that in a very short time one will learn just about how to space the apples so that an amount approximating a certain number of boxes is left. This spacing will, of course, vary with the variety, the average being about six inches. If trees are well set with fruit so that an even distribution can be brought about, all clusters should be broken up until no two apples touch, and all fruit on the tips of small twigs should be removed. Careful, systematic work is necessary for the greatest success. He who goes into his orchard with a pole and knocks off some fruit here and there has not thinned. True, he has relieved the tree of some of its burden, but, in all probability, in such a way that he will not be repaid to any extent for his efforts.

## CHAPTER XII.

**INJURY AND PROTECTION OF APPLES FROM FREEZING.**

It has already been stated that one of the chief limiting factors in the production of apples throughout the various states of the Union is frost. It is true that there are certain sections of the country where frosts have seldom or never occurred to the detriment of the fruit crop. Experience of orchardists in California and elsewhere has led to the conclusion that no section, no matter how free it has been from killing frosts during the danger period of trees in the past, can be said to possess immunity, and there may come a time when the temperature will drop so low that buds, blossoms and fruit, if not trees, must succumb. There are, of course, many places where fine fruit is grown during favorable seasons that are visited by killing frosts periodically, and the chances for and against raising a crop are about even. Such sections do not offer the best advantages for commercial orcharding unless some practical means of protecting the crop during the danger period may be employed.

**PERIOD OF GREATEST DANGER FROM KILLING FROSTS.**

In the case of apples, the injury is usually done either to the buds, blossoms or small fruit in the early spring, about blossoming time, although a severe freeze during the winter season may kill the buds, which often stand temperatures ranging from ten to thirty degrees or more below zero. The period of greatest danger corresponds very closely to the time from when the buds begin to swell in the spring until the fruit has reached a diameter of a half inch. This time is, of course, subject to variations in climate, due to altitude or local conditions.

**BUD INJURY.**

Winter or early spring injury to buds may be detected by a discolored area seen in the center upon cutting them open. The pistil or central organ of the blossom is usually the first part to freeze and, once frozen, fertilization is rendered impossible. Blossoms so injured will sometimes develop, and the trees will come out in bloom and be just as beautiful as if nothing had happened. An examination of such blossoms will show the blackened pistil in the center. A peculiar form of freezing of apple blossoms, which has come to my notice in another state, destroys the petals entirely. The rest of the parts of the blossom develop normally, fertilization takes place as usual, and a good crop of fruit may set on the trees.

**FRUIT INJURY.**

Often fruit develops from frost-injured blossoms, but as a rule only when fertilization has taken place prior to the injury. In Bulletin 91 of the Montana Experiment Station, Prof. O. B. Whipple gives an interesting account of the parthenocarpic development (development without fertilization) of apples, most of which were seedless and core-

less and unfit for use commercially. It is a very common thing to find seedless apples or pears during a season following a freeze at blossoming time or shortly afterwards. Fig. 45 is a picture of two Yellow Bellflowers picked from the same tree. One apple is almost true to the type of this particular variety; the other is very much flattened



Fig. 45.—Normal shaped Yellow Bellflower on right, abnormal on left because of frost injury. (Original)



Fig. 46.—Normal shaped Yellow Bellflower on right contains well-developed seeds; abnormal frost-injured specimen on left has none. (Original)

and distorted. Most of the apples in the orchard where these were picked resembled the latter, and it was difficult to find a typical-shaped Yellow Bellflower. All apples of this shape were seedless. This trouble might easily be confused with distortion of apples from the attack of

purple apple aphid. This pest always leaves the apples small and misshapen, but well-formed seeds are present. Fig. 46 shows the same two apples as in Fig. 45, which have been cut open. A well-developed seed is shown in the core of the typical-shaped apple, while the other one has none.

Another form of injury is the so-called frost russet illustrated in Fig. 47. The russetting very frequently shapes itself in a band about the fruit, but in some cases may occur in the calyx and stem cavities. This injury is very commonly confused with that resulting from scab, Bordeaux injury and various other things. The presence of the characteristic bands as illustrated is a sure indication of frost injury.

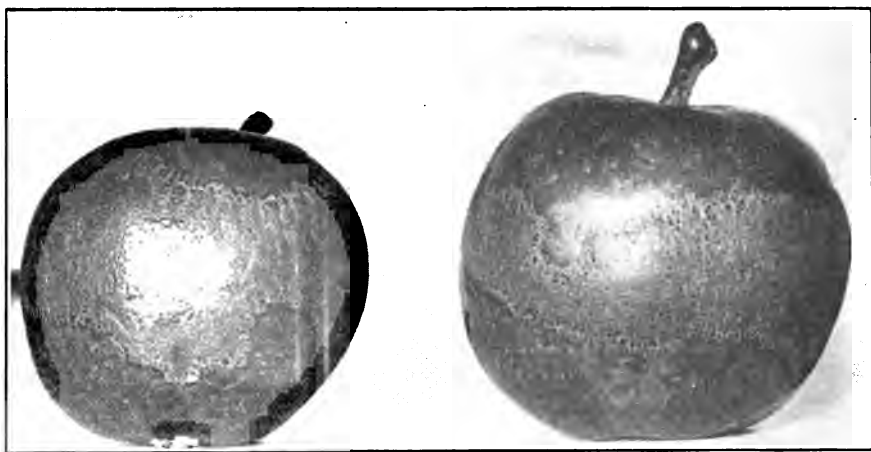


Fig. 47 —Frost russet band on apples. (Original)

#### LEAF INJURY.

A peculiar crumpling or blistering of the leaves of certain varieties usually follows severe spring freezes. The epidermis of the leaf may separate from the inside portion wherever these blisters occur. Such leaves are apt to turn yellow and drop very early in the season. This form of injury is not serious.

#### SUSCEPTIBILITY OF VARIETIES.

Some varieties of apples will stand much more freezing than others. Again, some varieties will blossom much later than others, thus escaping a frost that would injure earlier blossoming varieties. It is, therefore, wise for the orchardist who lives in sections of killing spring frosts to select the hardiest, and in some cases preference should be given to late blooming varieties. As an illustration of this fact the Rome Beauty and Ralls apples blossom much later than the Ben Davis and Jonathan, consequently often escape injury when the latter named varieties are killed by a freeze coming about blossoming time.

### FROST PROTECTION.

It is safe to say that the orchard which is well cared for in general is less liable to injury from freezing than the one which is neglected. The first point which should be emphasized, then, in connection with protecting the orchard from killing frosts, is proper care. Cultivation, pruning, fertilization, irrigation and spraying are all necessary at certain times for the best development of trees, including the fruit buds. If the buds can go into the winter in perfect condition, there is every reason to believe that they will stand more than they would if devitalized because of unhealthy trees.

### SMUDGING.

It has long been known that there is little danger from killing frosts on a cloudy night. This fact has led to a belief that the same protection afforded by the clouds can be produced artificially by means of smoke. With this idea in view, various materials which in burning will produce much smoke, have been burned in orchards during frosty nights. This method of protection is known as smudging, and is fast giving way to the better method of heating. It is probable that light frosts have been warded off by means of such smudges, or at least a sufficient blanket has been formed over an orchard in the early morning to prevent the rapid thawing of the blossoms which, if thawed out too rapidly, are sure to be killed. It is now thought that smudging in itself is of little value, and many of the successful orchard heaters now in use are designed to utilize as much of the fuel as possible; the more complete the combustion the better they are thought to be.

### ORCHARD HEATING.

While there are still many problems in connection with orchard heating yet to be solved, it is now generally conceded that, under certain conditions, at least, a crop of fruit—citrus or deciduous—can be saved, even though the temperature falls as much as fifteen degrees below freezing. During spring freezes of four different seasons in Colorado, the writer had abundant opportunity to study the various operations of the orchard heating business in time of action, and the effect of such heating in saving fruit. The first practical demonstration of what could be accomplished was made in the spring of 1908. Three or four different parties had previously purchased some of the Bolton orchard heaters, which at that time were manufactured in California. By the use of these small lard-pail pots, as they were called, which held about three quarts of oil, these men succeeded in saving a considerable amount of fruit. The demonstration was a perfect one, for only in the heated areas was there any fruit. Before this time there were orchards in California where heaters had been used. The Limoneira Company had done considerable work along this line, and had used wire baskets for burning coal with more or less success. The fact that it was possible to save a crop of fruit by burning coal or oil in containers led to the making and patenting of a great many types of heaters, practically any one of which will do the work, provided that the necessary amount of fuel is burned. Both coal and oil have given satisfaction, but the latter is preferred by most orchardists. In California, where oil is so

cheap and coal is so high, it does not seem as though any one would be justified in purchasing coal heaters. It would not be wise to recommend any particular make of heater in this book. In general, the reservoir type of oil heater is the most satisfactory. One can scarcely afford to purchase heaters and other equipment for the work and then fail because of an insufficient supply of oil. Of course, it is possible to refill small heaters, or to have a reserve supply of them on hand, but such entails extra work and expense at time of heating when it is often hard to get enough help.

#### **PLACEMENT OF HEATERS IN ORCHARD.**

One heater for each tree is ordinarily used. These heaters are commonly placed in the center of the rectangle formed by four trees.

#### **WHEN TO LIGHT.**

Firing should begin before the temperature has reached the danger point, the object being to keep it at a certain point rather than to let it drop below and then try to raise it again. For example, it is much easier to maintain a temperature of thirty-two degrees when the outside temperature is twenty-five degrees than it is to raise it to thirty-two degrees, after it has dropped down to twenty-five degrees. While fruit buds or blossoms may stand this temperature for a short time, it is never safe to let it get so cold.

#### **KEEP FIRING WELL AFTER SUNRISE.**

Many a crop of fruit has been lost because fuel played out, or because men became tired or careless and let fires go down at daybreak. The coldest period is very often about sunrise and the heaviest firing is necessary at this time.

#### **USE ONLY TESTED THERMOMETERS.**

To depend upon a twenty-five cent thermometer in the orchard heating business, when thousands of dollars are at stake, is inexcusable foolishness, and yet such has often been done. Nothing but reliable, tested thermometers should be used in this important work. Several should be used and placed in different parts of the orchard, as there may be quite a temperature variation in a short distance. Electric alarms may be used, but it is more satisfactory in actual practice to have reliable men to watch the thermometers and record temperatures every few minutes during the time of expected freeze.

#### **SUCCESS MEANS HARD WORK.**

Our present knowledge of frost fighting with orchard heaters is not such that it can be recommended under all conditions. With the temperatures that we usually have during the period of spring freezes in California, it is safe to say that the man who is willing to observe all the details, and who is not afraid of the hardest kind of work, will succeed. Not every man who has orchard heaters does, neither does every man who sprays make a success of that operation. Orchard heating, if it is done at all, should be done rightly, or else all labor and expense may be thrown away. No one who is looking only for the easy jobs should have anything to do with this work.

## CHAPTER XIII.

## SPRAYING THE APPLE.

Whether it is generally believed or not, it is nevertheless true that an exceedingly heavy loss in apples each season could be largely prevented by proper spraying, and while there are many orchardists who spray intelligently and who get results, there are others who spray with little or no knowledge of the diseases or insect pests of their trees, and little more of the sprays that they are using. The first thing that the apple grower should do, if he would make the greatest success of his business, is to familiarize himself with these pests and diseases. It may seem to him that this is the work of an expert and he should not be expected to know anything about it. There is no question but that the expert's advice and help should be solicited, but after all every one must know his own orchard, and with the help of such expert advice as he may be able to get, and through reading, it should be possible to learn everything that need be known about the insects and diseases, so that intelligent methods may be used for their control.

There are too many apple growers spraying for codling moth, not even knowing where the eggs of the adult insect are laid or what they look like; there is too much spraying for the control of the various species of plant lice without a thorough knowledge of their life habits; and the same thing holds true in relation to apple scab, mildew and other affections of the orchard. To illustrate, I have talked with seemingly intelligent growers who thought that the arsenate of lead applied for the control of codling moth would kill the eggs. Such ignorance as this is, of course, not met with as a rule among our fruit growers, for it may be said to their great credit that there are no more intelligent people to be found in any other line of work; but one can not conceive of such lack of knowledge in regard to a pest upon which volumes have been written and with which every field expert in an apple section is familiar.

The writer is not a believer in promiscuous hit or miss spraying, done usually because some one else is doing likewise, or because some one said that the trees needed treatment, without any knowledge of what was on them. The time to spray an apple orchard is when there is something on the trees that can be controlled by the spray. It is all very well to talk about preventive measures, but spraying an orchard for woolly aphis with a nicotine solution, or with some other contact spray, will do no good for the control of this pest, unless it is actually present. There can be no preventive effect in this case and yet we often hear people say: "Well, I had no pests on these trees but just sprayed to prevent them from coming." Again, there could be no possible value of an arsenical spray for codling moth unless the pest was actually present in the orchard. There are isolated orchards of a considerable age where this pest has never occurred, and it would be the merest folly to attempt to prevent its coming by any spraying methods. There are also young orchards in sections where codling moth is present that may not be troubled for a few years, and there can be nothing accomplished in spraying them until the moth arrives. It is always a good



thing to keep ahead of the various pests and spray before they become too bad, but spraying costs money, so much that it is often done poorly in an attempt to save material, and too much emphasis can not be placed upon the necessity for orchardists acquiring sufficient knowledge of the various pests and diseases, so that they may know when spraying need not be done, or when it must be done in order to best protect the trees or crops. Because of the lack of knowledge in this work many have advocated a certain course of spraying to be given each season regardless of condition of the orchard or its previous record with respect to the pests. There may be sections where such a course can be outlined and followed out to advantage, but orchards differ as do individuals or groups of individuals, and what one requires may be absolutely unnecessary for another, so after all the owner must study his orchard and learn to know for himself what is best for it.

Failure to control the various pests of the orchard when certain of them are present and when the right kind of an insecticide or fungicide is used, is more often due to lack of thoroughness in the application than to everything else. The writer has heard orchardists, time and again, condemn certain sprays as being poor when they themselves were to blame for the poor results attained. At one time an orchardist had sprayed some young apple trees with Black Leaf "40,"—1-1000—for the control of the green aphid and when he got through the trees were still badly infested. He immediately complained that the material used was not good. An investigation of the orchard showed that quite a large percentage of the aphids had been killed but that there were still enough left so that without further spraying nothing of value would have been accomplished. For the purpose of a demonstration a few trees were re-sprayed with a drenching rather than a light application. In this case practically one hundred per cent of the lice were killed, proving that the spray was good but that the methods of application were faulty. When we stop to think that in cases of this kind the time and material is often thrown away, whereas a little more care and a little greater thoroughness, although it will cost more, will bring results, there is little excuse for hasty, careless work. While it is possibly not a good thing to advocate as a general practice, it is usually better, from a financial standpoint, to spray one half of an orchard very thoroughly than to spray the whole thing for possibly the same cost and slight the work. In the first case a good crop of apples may be harvested from half the orchard, while in the second the loss may be total.

A few years ago the writer sprayed a part of a very old apple orchard in southern Maryland, which had not received a spray for a long time, and possibly never. The apples for years past had dropped from fungous and codling moth attack. In this case probably not over one third of the orchard was sprayed, by the use of a barrel pump and an ox team, but for the first time in years it produced salable fruit which sold for a big price, but only the sprayed trees had good fruit. This was a most striking example of the possibility of protecting even a small part of an orchard by heavy spraying. When negligent orchard owners can be made to see the value of heavy spraying by starting in first on a small portion of the orchard for economy's sake, such work will often lead to the same kind of spraying over large areas.

Thoroughness in spraying implies good spraying machinery and equipment. The day of the barrel pump is practically over as far as the commercial orchardist is concerned, and the man who owns five acres of apples needs a power sprayer. For a smaller acreage the barrel or tank pumps may still be used, but only by exercising the greatest of care can they be made to do the work as thoroughly and as effectively as the power outfit. Our modern power sprayers have revolutionized the spraying business and have made it possible to handle a much greater acreage during the period when spraying can be most effectively done, and if any criticism is to be made of these machines it would be that the high degree of efficiency which they possess is sometimes depended upon too much and the men, trusting to the machine to do it all, become careless. While it is true that with the high pressure which it is possible to attain trees may be very quickly sprayed, there is a tendency to hurry too much and the work is slighted.

Most of our power sprayers will maintain a pressure of two hundred pounds with ease, while with the old fashioned barrel pump or the later tank pump eighty to one hundred pounds was considered good. Thorough work may be done with this lower pressure, but the time required and the care necessary are greatly increased. It is, however, advantageous to have the higher pressure in the case of control work for most of the insects of the apple.

There are many good types of spraying machines on the market and individual likes will determine which is to be purchased. A machine should be equipped with two long lines of hose, at least fifty feet each, and rods at least eight feet in length. The long hose will enable one to get around trees handily and the long rods will greatly facilitate the work of spraying. Of utmost importance in the equipment are good nozzles. No machine can be expected to do the best work without them.

#### THE PIPING SYSTEM FOR SPRAYING.

The great success of the piping system used by a few California orchard growers indicates the possibility of this latest method of distributing and applying the sprays to our trees coming into general use. Under this system the portable tank with attached pump and gasoline engine is done away with and instead there is installed, at a convenient place in the orchard, stationary mixing tanks for the spray material and a system of pumps which forces the spray under pressure through leads of half inch galvanized iron pipes buried at a convenient depth and convenient intervals throughout the orchard. Standpipes for the attachment of the hose are connected to the underground system at such distances apart as are necessary. The initial cost of such a system is, of course, considerable, and not every orchardist can afford its installation. The great saving in time and labor during the work of spraying, the ability to spray an orchard when the ground is wet, and the possibility of so much more effective work, make the system one to be recommended.

Instead of the pipes being placed permanently below ground as in the Hayward Reed system, used in his pear orchard near Sacramento, a modification of this system may be used. At Watsonville the latter may be seen in operation and consists of suitable lengths of pipe which at the time of spraying are laid on the surface of the ground between

the orchard rows and the liquid spray is pumped through them under a high pressure from a central pumping plant located at a well which furnishes the water supply. This system is said to work satisfactorily.

It is the firm belief of the writer that the future will see a great many of our better orchards sprayed by the piping system. The gasoline power outfit, while we must recognize it as being an effective piece of machinery, has its drawbacks and its limitations. An engine mounted on a truck pulled over rough ground and often drenched with caustic sprays can not be kept in the very best working order and often the fluctuation in pressure is responsible for variable results in spraying. With the piping system engines and pumps can be protected in the best possible manner, spray materials can be much more conveniently handled, and a great deal of the present dread of spraying may be removed. The spraying of large apple trees is not any easy matter and requires so much material that one power sprayer is often inadequate to handle more than twenty-five acres, where spraying must of necessity be done quickly to get the desired results. For instance, the calyx spray for codling moth must be done during a period of little more than a week, if complete calyx control be assured. In a twenty-five acre apple orchard, with seventy trees to the acre, there would be seventeen hundred and fifty trees. If they are large, a two hundred gallon tank will not thoroughly spray over fourteen trees; that is, one hundred and twenty-five tanks of spray would be required for such a twenty-five acre orchard. It is considered to be a good day's work to put on ten tanks of spray, so twelve and one half days at this rate would be required to spray twenty-five acres. It is with a full realization of being disputed and possibly ridiculed for these figures that they are published, but it is only asked that a careful investigation of the many failures to get results in spraying be carefully made by those who would disbelieve them, and a full assurance of their approximate correctness is undoubted.

Before closing this chapter on spraying, a few words, treating of the importance of the "man behind the gun" should not be omitted, for the very best equipment may be of little value with careless, irresponsible men entrusted with the work of spraying. The most important men in a spraying crew are those who hold the rods and direct the spray upon the trees. Their sight must be keen, they must be active and alert, and they can not be thinking of other things continually and do a good job of spraying, for this usually means the thorough wetting of every portion of a tree; and how easy it is to slight the work just enough to defeat the object of the spray. Men who hold spray rods should be gifted with enough intelligence, at least, so that they could be made to know that upon the manner in which they do their work will depend the success or failure of the spraying operation.

Recently while watching some Chinamen spray an orchard for the control of codling moth, it was noticed that they had no conception of thoroughness and apparently no realization of the important part they were playing in the work. Upon trying to explain to them that the work should be more thoroughly done they seemed quite indignant that any one from the outside should attempt to show them anything. If this important job must be entrusted to the poorest among unskilled laborers, their instructions should at least be so complete that the work might not suffer.

## CHAPTER XIV.

## INSECT PESTS OF THE APPLE.

## CODLING MOTH.

As failure to control the codling moth means failure to make a financial success of the apple business, a full discussion of this most serious of all apple pests seems necessary in a work of this nature.

The annual loss in fruit from this pest is tremendous and could we secure accurate figures they would be startling. Practically every apple grower has at some time or other paid it toll in apples destroyed, and others have allowed their crops to go year after year without making any effort to save them. Despite the fact that it is so common and so destructive a pest, it is one that is largely under our control and any orchardist who is willing to use brains in fighting it is going to meet with success. It is true, however, that the codling moth sometimes gets so bad in a locality that one or two seasons of most careful and heavy spraying are needed to reduce its numbers to a point where control will be comparatively easy. Again, its control may in some cases be a community problem, where all must join in the fight if they would succeed themselves or protect their neighbors. It is not known just how far the moths will fly, but surely from an orchard on one side of a road to one on the other. Thus one may have to fight harder because of the negligence of a neighbor who fails to spray.

**How the Pest Spends the Winter.**

A knowledge of the wintering habits of an insect is sometimes a valuable thing in connection with its control. In this case we have a pest that winters in such a way that something, but not all, may be done toward its control during the winter or dormant season. After the full grown second brood larvæ leave the apples in the fall or winter they secrete themselves under the loose bark of trees in the orchard, in cracks between boards in packing or storage houses, in fact almost anywhere that they can find hiding places. As a majority of the wormy apples usually fall to the ground before picking time, the worms in them that may escape can readily reach trees where hiding places may be found. Very frequently, however, they leave the apples while they are still hanging to the trees, and crawl down the limbs and trunk until suitable quarters are discovered. When such are found the larvæ immediately begin the construction of little cocoons of silk, which when completed form a protection against the weather and enemies that might prey upon them. In this cocoon they remain as full grown apple worms or larvæ throughout the entire winter season, and never can they be found in any other stage during this time. By scraping off the loose bark on old trees, in particular, frequently large numbers of these hibernating larvæ may be destroyed. Such should always be done when an attempt is being made to control the pest in an orchard or collection of orchards, where spraying has been neglected until the codling moth has become so abundant as to make spraying work more or less ineffective.

The natural mortality due to weather conditions during the winter time is sometimes great, but varies from season to season. The numbers that survive until spring to develop into moths have an important bearing on the ease or difficulty with which this insect may be controlled. If a winter season is such that seventy-five per cent of the worms which began hibernation in the fall transform, the females to lay eggs in the spring, it would be expected that a much more serious condition would result, providing no spraying were done, than if only ten per cent had lived through. As the number of larvæ that are present in the spring will determine largely the number of applications of spray that are necessary, and as a superabundance may mean the loss of a great many apples, no matter how carefully the work of spraying is done, too much attention cannot be paid to destroying the larvæ during the winter season, beneath hands put on trees as traps in the summer, and in every way possible to reduce their numbers to the minimum.

#### **The Pupal Stage.**

When the warm weather of spring comes on the larvæ which have survived the winter begin to pupate, and in the cocoons may be found little brown, footless, quiescent creatures, not able to move about, and aside from a slight movement of the portion corresponding to the abdomen of the adult which will soon emerge, they are immobile. This stage may last several weeks in the spring, but in the case of first brood pupæ it averages about two weeks. From this stage there develops the mature winged moths, the females of which, after mating, begin egg laying.

#### **The Moth Stage.**

No orchardist who grows apples can reasonably find any excuse for not knowing the appearance of the codling moth, and yet there are those who are apt to mistake almost any kind of a common cutworm moth for this destructive species. A few mature larvæ or pupæ, collected and put in a pasteboard box any time during the spring or summer season, will develop into moths and the characteristic appearance may then be noted. They are gray in color with distinct yellowish, almost gold colored spots near the tips of fore wings and a wing expanse of not over three fourths of an inch. The characteristic yellow markings make this species readily distinguishable from practically all others, and yet we find men who should know better, trapping moths by lights, mostly cutworm species, and claiming that they are destroying the codling moths.

#### **The Egg Stage.**

Contrary to the general opinion codling moth eggs are not hard to find when one learns what they look like and where to look for them. They are laid singly on the foliage or fruit, and rarely on the twigs. If found on the former, in practically every case they will be found on the upper or smooth surface of a leaf and almost always close to an apple or cluster of apples. The moths seem to possess an instinct which prompts them to lay these eggs where the little worms, upon hatching from them, will have little trouble in locating some of their food—the fruit. In shape the eggs are almost circular and very flat, adhering closely to the surface of a leaf, or apple. The diameter is about that of the head of an ordinary pin. On the surface there is more or less

of a wrinkled or roughened appearance. The color at first is creamy white. In a few days—three or four—a reddish ring may be plainly seen within the shell. This ring marks the position of the embryonic larva developing within. Before hatching, which normally takes place about the seventh day, there may be seen a black spot near one side of the egg. This spot is simply the black head of the little worm within and indicates that hatching time has arrived. The thin white shells of hatched eggs may cling to leaves or fruit for some time and can be seen in any orchard where codling moth is at all bad, during the summer season.

#### Control.

A very large per cent of the first brood larvæ begin feeding in the calyx end of the apple, the number varying somewhat with seasons, locality and variety, and estimated by scientific workers to be from seventy-five to ninety-five per cent of the total brood. In the case of the second brood quite a large percentage also enters the calyx, but as the fruit is large when they come on there is a better chance for the little worms to enter elsewhere, and quite a good many bore into the fruit through the stem cavity or somewhere on the side. This fact, coupled with the important one bearing on it, that sprays must be applied to coat the entire surfaces of the apples, makes it of the utmost importance to devote every energy toward killing practically the entire first brood, so that the second as a consequence must be small.

The fact that so great a percentage of the first brood of worms seeks the calyx as soon as hatched has resulted in the standard method of control for this pest, viz: a heavy spraying with some arsenical insecticide when the petals are practically all off and before the calyx lobes have closed.

#### Spray to Use.

The most satisfactory and widely used arsenical spray for codling moth is arsenate of lead. It is made in both the paste and powdered form, the first mentioned being used more generally than the second. Other arsenicals that may be substituted for the arsenate of lead are arsenite of zinc and Paris green. The arsenite of zinc is a good poison, but has not given general satisfaction because of its liability to burn fruit and foliage. It is, however, used considerably for the first or calyx spraying, as little damage seems to result from its application at this time. Later applications are dangerous. Paris green, when substituted for these others, should be applied with milk of lime in small quantities, to prevent burning.

#### Strength of Spray.

Arsenate of lead in the paste form should contain from 12 to 17 per cent arsenic oxide. Three or four pounds of this paste to 100 gallons of water is of sufficient strength to kill the larvæ. It is probably a good plan to increase the strength somewhat for the later sprayings, applied for the purpose of coating the fruit. The powdered form of lead arsenate contains about double the amount of arsenic oxide per pound, hence only one half as much is necessary for a given amount of water. The same is true of zinc arsenite. Paris green should be used at the strength of one and one half pounds to 200 gallons of water, with the addition of about ten pounds of strained milk of lime.

The strength of spray to use as given in this publication is less than the manufacturers of arsenicals usually recommend. It has been proven by careful experiments that the amount given is ample and special emphasis should be laid upon the necessity of putting the spray where it belongs. It matters not how strong a spray is used, it can do no good unless it is placed where the worms will feed upon it. Time and again in the writer's experience have orchardists been known to condemn the spray as faulty, when they themselves were to blame because of their careless methods of application.

#### How to Apply Spray.

It seems almost superfluous to say anything about how to apply a spray, but after all there is much to learn before the beginner can become expert. The tendency is always to use too little spray, thus slighting the work. In making the application for codling moth, thoroughness is the keynote to success and anything that will bring it about is desirable.



Fig. 48.—Apples on the left just right to spray; calyxes are too nearly closed on apples shown on right for the most effective work. (After Quaintance)

Only the most careful help should be engaged, and men should be trained to do the work so that, when a tree is finished, they know that they have sprayed it from every angle. This necessitates walking entirely around a tree. Spraying that is done from one side only cannot be thorough and is of little real value. There is a tendency for sprayers to hold the nozzle too close to the limbs and, as a consequence, the tips are very often missed. While a tree must be sprayed on the inside, it must not be neglected on the outside, and by holding the nozzle two or three feet back from the extremities of the longest branches, as the tree is encircled during spraying, there can be little of the surface missed. In all spraying work for codling moth the apparatus should be of the best. Long rods with forty-five degree angles on the tips, and a driving spray with high pressure, will greatly facilitate the work.

#### First Spraying.

There are few orchardists who have had experience in spraying for the control of this troublesome insect the country over, who will discount the value of the calyx spray. This must be applied before the calyx

cups close and fortunately there is a period of a week or more with most varieties of apples, after the blossoms fall, when the calyces are open, and a few rare cases where they never close tight. Varieties, soil and climatic conditions bring about this variation. Knowing that a large percentage of the first brood worms enter by way of the calyx, and that every one that escapes being killed by the first spray and develops into a moth of the second brood—which if a female may lay seventy-five eggs to hatch into second brood worms—we cannot be too careful in making the first application. The aim should be to fill every calyx cup with the liquid, which, upon evaporating, will leave a deposit of insoluble arsenic to remain in and protect the apple throughout the entire season. Every sprayer should test the efficiency of his work by examining trees, after he thinks they have been well sprayed, and see if there are any calyces that are dry and have not been touched by the spray. If this is done one will soon realize how exceedingly hard it is to fill every cup. As many of the blossoms point upward, spraying from a tower is often practiced and is a decided advantage when trees are large.

As varieties of apples differ as to the time of blooming, there is frequently trouble experienced in getting the spray on trees of certain kinds at the proper time. This trouble is greatly exaggerated in our older orchards, where many varieties have been planted and where there may be great differences in their blooming habits. It is not serious in orchards of large blocks of a few varieties, for those that bloom first can be sprayed first and the others will probably be in good condition immediately afterwards. Climatic conditions are sometimes such that the blossoms of a given variety do not come out evenly. Where such is the case a double application should be made for the calyx in order that the greatest efficiency may result. If this repeat spray is found to be necessary it should be applied from a week to ten days after the first or regular calyx spray, when the majority of the blossoms have fallen.

#### **Second Spraying.**

Already two sprayings have been mentioned, but in actual practice the second calyx application is not usually found to be necessary. The regular second application, which it is never safe to omit if codling moth is at all hard to control, should be made about three weeks after the first. At this time there may still be a few of the calyces open, and it will have some value as a calyx spray. Its chief value lies in the fact that it is applied at a time when the worms are beginning their work, and many may be killed on the sides of little apples which will, at this time, receive a coating of the arsenical.

#### **Third Spraying.**

A third application two weeks after the second is often desirable to supplement the work of the latter. The little apples grow very rapidly when they once become set, and difficulty is experienced in keeping a protecting coat of spray over a large part of the surface. As the apples grow, the individual particles of arsenate of lead become correspondingly farther apart and the worms have a better chance to gain entrance. The third regular application will be put on at a time when the hatching of first brood worms is about at its maximum; hence it is a very desirable spray during seasons of an abundance of codling moth.



**Fourth Spraying.**

Generally speaking, three sprays are sufficient to control the codling moth, provided that they have been rightly timed and thoroughly applied. The writer has known of many cases, however, of serious infestation where this spray and another following could be made to pay. They are only necessary when the pest becomes overly abundant because of previous seasons' neglect. When applied, this spray should be put on about fifty days after the second regular application. The latter was put on about the time when the first brood of eggs were beginning to hatch, and as the second will begin approximately fifty days from this time, or in other words, as it takes the insect seven weeks to undergo all its transformations in a brood, the spray is timed to the hatching of the first of the second brood.

**Fifth Spraying.**

This application is simply to supplement the fourth and should be applied about two weeks later. Its use will insure a better coating of lead arsenate on the apples and thus bring about greater efficiency in killing worms.

**Other Control Measures.**

Generally speaking, careful attention to spraying will bring about complete control of codling moth. Conditions may become such through neglect or otherwise, that something else must be done to reduce the numbers of the pest sufficiently for effective spraying. To illustrate, the writer once sprayed an orchard where codling moth was so abundant that one tree left without spraying had only seventeen per cent of the fruit sound at picking time. Five sprayings in this orchard, all heavily and carefully done, were necessary, but even after all this spraying a considerable percentage of the apples were actually wormy, or were specked where worms had attempted to eat in and were killed. In such cases as this, cloth bands of burlap or other material, placed about the trunks of the trees about June first and removed, and all worms underneath killed every ten days until apples are picked, would result in such a reduction of the worms that the second brood would be less troublesome and fewer worms would go into winter quarters. Burlap bands should be of three thicknesses, about five inches wide, and may be held in place with thumb tacks.

Removal of rough bark on old trunks is always desirable, as many larvæ hibernate underneath.

Packing-houses frequently serve as harboring places for worms, which crawl from apples brought in for packing or storage. These may find cracks between boards, boxes or rubbish of any kind in which to spin cocoons and pass the winter. Screening of such houses to prevent the exit of moths in the spring is sometimes desirable.

**APHIDS AFFECTING THE APPLE.****The Woolly Aphis of the Apple.**

(*Eriosoma lanigera*.)

This very common and destructive pest is so well known to every apple grower that it hardly seems necessary to go into details regarding it. Not only is it common, but it is also one of our hardest pests to

control. Its name is derived from the fact that the purplish body of the adult louse is covered with a wool-like, waxy excretion. When once an orchard becomes badly infested it is only with extreme difficulty that this insect may be checked in its ravages.

The woolly aphid works both above and below ground. The damage to the roots consists in a roughening or knotting of the surface, with the result of more or less decay and destruction of fibrous roots in bad cases. The winter season is spent by the lice both on the branches and trunks above ground and on the roots below the surface. During the summer months a migration is taking place from roots to branches and vice versa, throughout the time of active feeding, with usually a more general migration in the early spring and late fall. One winged generation develops during a season, and this in the fall. These winged lice are all viviparous females and give birth to sexual males and females, the latter of which each deposits a single large egg. It is now thought that migration takes place from the apple to the elm, and that the eggs are deposited on the latter,<sup>5</sup> as the eggs cannot be found on the apple trees, though search has been made for them there time and again.

#### Control.

When damaging trees above ground this aphid, like others of its kind, may be readily killed by a spray of Black Leaf "40" and soap, using the former at the strength of one gallon to 1000 gallons of water and about 5 pounds of soap to 100 gallons of water. They are not at all hard to kill with this mixture when it comes in direct contact with their bodies. In order to make it do so a high pressure and a driving spray is necessary. In small orchards we have known this pest to have been kept in check, in the early spring, by the application of coal oil by means of a brush, to colonies located in cracks, knot holes, etc., as they colonized after migrating from the roots.

Underground treatment has been on the whole unsatisfactory. In the case of small trees, tobacco dust or a spray of Black Leaf "40" and soap to the bared roots may be quite effective. For larger trees the treatment is not practical, as the aphids follow the roots to their extremities, especially if they are shallow.

Deep rooting of apple trees is desirable, because of the tendency of this pest to attack the shallow roots most severely, as well as for other good reasons.

#### Resistant Varieties.

Some varieties of trees possess more or less resistance to the attack of woolly aphid. The Northern Spy probably is more nearly immune than any other variety and for that reason the roots are very often used for propagating purposes.

#### Natural Enemies.

Lacewing flies, syrphid flies, and ladybird beetles frequently keep this pest in check. There is no more effective predaceous enemy in this case than the lacewings, and exceedingly bad infestations over large areas have been seen destroyed in a couple of weeks time by them. A little internal parasite, *aphelinus mali*, is sometimes a considerable factor in its control.

<sup>5</sup>See Bul. 217, Maine Exp. Sta.—Edith M. Patch.

### The Green Apple Aphis.

(*Aphis pomi.*)

The little shiny black, oblong eggs on the new growth of apple twigs during the winter season, have been seen by practically every apple orchardist. These are the eggs of the green apple aphis, laid there by a small green plant louse in the fall. As the buds begin to open in the spring these eggs hatch and the little dark green colored lice immediately begin feeding upon the new growth. These first spring lice, which hatched from the overwintering eggs, are known as stem-mothers. When they become mature after a couple of weeks of feeding they give birth to living young of a second generation. These in turn do likewise, and a number of generations are developed throughout the season. Many individuals after the second generation develop wings, and thus may fly about from tree to tree and orchard to orchard, spreading the infestation. In the fall true males and females are developed. These are wingless and may be distinguished from the agamic forms by their color, which is yellow instead of dark green. The females deposit the eggs previously described. Their injury is done principally to the leaves, although in bad cases the fruit and even tender twigs may be attacked. The sap is sucked from the parts upon which feeding takes place. A curling of the leaves is a good sign of the presence of this insect. Ants feed abundantly upon the excrement or honeydew, and are always present in annoying numbers when infestation occurs. Pear, quince and hawthorn are subject to attack, as well as the apple.

A thorough spraying with Black Leaf "40" and soap, at the strength recommended for woolly aphis, or distillate or oil emulsion in the spring when eggs are hatching, is effective. Any of these sprays may be used later in the season to advantage. Lime sulphur, 1 part to 10 parts of water, is supposed to possess some virtue as a dormant spray for the eggs. Observations made in Colorado by the writer did not justify its use, except when it was put on just as the eggs were beginning to hatch early in the spring. If applied before hatching time it may have some virtue, but results attained have been variable.

### The Purple Apple Aphis.

(*Aphis sorbi.*)

This is without doubt the most serious aphid pest of the apple, as far as their effect upon the fruit is concerned. Like the green apple aphis, they spend the winter in the form of small black eggs on apple trees, which hatch very early in the spring. Almost before the buds have begun to swell perceptibly, the little blackish colored lice may be seen hanging on the outside waiting for them to open. Feeding begins immediately upon the bursting of the buds. After about three weeks' time these stem-mothers have become mature and reproduction without egg-laying begins.

The second generation is purplish in color, the lice being covered with a powdery secretion. Feeding takes place very generally on the leaves, close to the clusters of young apples, and more rarely on the apples themselves, which are injured to such an extent that they become stunted and not only fail to mature, but are distorted so badly that the variety may not be recognizable.

During the month of June, according to O. E. Bremner, wings are developed and a migration takes place from the apple to some intermediate host, which has not yet been discovered. The writer has observed this habit of the louse in Colorado, and H. F. Wilson reports that a similar migration takes place in Oregon. Mr. Bremner, who has done more work on this species in California than any one else, states that he has found the aphid on careless weed (*Amarantus retroflexus*), but does not report having found it colonizing or feeding upon this plant.

In the fall winged lice return to the apple and produce sexual forms, the females of which lay eggs for the perpetuation of the species.

#### Control.

The very early hatching of the eggs makes it necessary that a spring treatment for this pest be made accordingly. The writer has found hatched lice of this species in February in Colorado, and there are no doubt seasons in California when just as early hatching would take place. Professor Wilson reports finding them in Oregon as early as February 22d, in 1912. The stem-mothers become quite resistant to contact sprays as they approach maturity; also, because of the protection of foliage at this time, spraying is often done with very poor success. The ideal time to spray is just as the eggs are through hatching, and while no date can be set, the time will conform closely to that of the swelling of the buds. Such work should not be neglected until the blossoms begin to appear, as this is too late for the best results.

Professor Wilson recommends an early spring treatment with a combination of lime sulphur and Black Leaf "40." Mr. Bremner has had splendid success with fall treatments when the sexual forms of the lice are present, using a crude oil emulsion formula which is made as follows:

"Place 88 gallons of water in the spray tank and add 1 to 2 gallons liquid soap, depending on the softness of the water used, diluted with about an equal amount of water. Agitate until thoroughly mixed and then with the agitator running add 10 gallons of crude oil."

A second formula recommended by Mr. Bremner follows:

"Dissolve 10 pounds of whale oil soap in not less than 10 gallons of water by boiling; slice the soap and it will dissolve more quickly. Place this in the spray tank, which should contain about 10 gallons of water. Thoroughly agitate and add enough water to make 90 gallons, then add 2 pounds of caustic soda (concentrated lye), dissolved in water. With the agitator running add 10 gallons of crude oil slowly."

Either formula is said to be effective and spraying should be done about November 25th in the Sebastopol section, where Mr. Bremner did his work.

#### Other Species of Apple Plant Lice.

The three species already treated are the only ones of any importance that have been taken on apple in California. Occasionally other species are found in limited numbers. C. P. Gillette and E. P. Taylor, in Bul. 133 of the Colorado Experiment Station, and H. F. Wilson in the Biennial Crop Pest and Horticultural Report, 1911-1912, of the Oregon

Agricultural College and Experiment Station, mention the European grain aphid (*Aphis avenæ*) and the clover aphid (*Aphis bakeri*) as being of more or less importance. These species are not commonly found on apple in California. The melon aphid (*Aphis gossypii*) and the sweet clover aphid (*Aphis medicaginis*) are occasionally taken on apple, but are never serious.

### MISCELLANEOUS APPLE PESTS.

#### Apple Tree Leaf-Hopper.

(*Empoasca mal.*)

Infested leaves appear more or less mottled with whitish markings, similar to those injured by mites. An examination of such leaves will disclose the fact that little white bodied, sucking insects are feeding underneath. These hatch from eggs laid in the bark of young growth. Wings are developed during the season and upon the slightest disturbance to the trees the insects take flight, and when infestation is bad swarms of them may be seen in the air.

A spray of Black Leaf "40," 1 to 1000 and soap, to kill the larvæ, is effective. Essig recommends whale oil soap, 1 pound to 8 gallons, or oil emulsions.

#### San Jose Scale.

(*Aspidiotus perniciosus.*)

This scale insect is more commonly found than any other on apple trees in California. It is very easily recognized, because of the fact that it causes small red spots to appear on the bark and fruit wherever it attaches itself. The scale covering varies from gray in the larger specimens to sooty black in the smaller. Underneath these scale coverings may be seen the little yellow bodies of the insects themselves, which live by sucking sap from the bark through their little beaks by which they are attached to the twigs. The pest winters in different stages of growth. It may be controlled by a spray of either lime-sulphur or an oil emulsion during the dormant season.

#### Oyster Shell Scale.

(*Lepidosaphes ulmi.*)

This scale was so named because of the fact that the covering is shaped somewhat like an oyster shell. During the winter season an examination will disclose the fact that there are a great number of little white eggs underneath the scale coverings. These hatch in the early spring, the little scales immediately attaching themselves either to the foliage or bark, where feeding begins. Lime-sulphur is recommended as a spray during the dormant season to control this insect. It is also readily held in check by means of oil emulsion sprays, just as the eggs are hatching in the spring.

#### The Scurfy Scale.

(*Chionaspis furfura.*)

This species may be distinguished by the dirty white scale coverings on the bark. Underneath there may be seen the purple bodies of the insects, or eggs of the same color.

Dormant sprays of either lime-sulphur or oil emulsions are used with success.

**Apple Tree Leaf Roller.***(Archips argyrospila.)*

In The Monthly Bulletin, Vol. II, No. 9, of the State Commission of Horticulture, the author published an illustrated article on this pest, telling of its habits and occurrence in the state. The adult is a yellow moth about the size of the codling moth, with white markings. Eggs are laid in oval shaped masses, each containing from ten to one hundred and fifty eggs, on the limbs and trunk in July. These hatch in the spring as buds are opening and the little whitish larvæ immediately begin feeding and, if plentiful, serious destruction of blossoms and defoliation of trees may result.

When full grown or about three fourths inch in length the larvæ pupate, mostly in the rolled leaves, though frequently elsewhere.

Complete control may be brought about by an early spring application of either a miscible oil spray or crude oil emulsion to kill the eggs.

**Apple Tree Tent Caterpillars.***(Malacosoma disstria and Malacosoma americana.)*

The former is the common species in California. Both may be recognized by the large web tents which are made where the colonies feed, after hatching from eggs which were deposited by the moths on the twigs the previous fall. These eggs are laid in masses encircling the twigs and are easily recognized from those of other pests because of this fact. Feeding usually takes place by the hairy caterpillars in quite definite areas within and surrounding the tents.

Control measures consist in removal of the egg masses when trees are being pruned in the dormant season, destruction of the web tents with the larvæ enclosed in the early morning or late in the evening, and arsenical sprays. Where spraying is done to control codling moth this pest is also satisfactorily controlled.

**Tussock Moth.***(Hemerocampa vetusta.)*

Considerable injury is sometimes done to young apples by tussock moth larvæ, and mature fruits are often seen in the packing-houses which show the scars due to this early injury.

Like the canker worm moths, the females of this species are wingless. The winter season is spent on the trees in the egg stage, in masses protected by the cocoons from which the female moths emerged.

The larvæ are quite resistant to an arsenate of lead spray, but arsenite of zinc is said to be somewhat more effective. Sticky bands are often used about the trunks of the trees to keep larvæ, which are shaken to the ground by jarring, from crawling back.

**Spring and Fall Canker Worms.***(Paleacrita vernata and Alsophila pometaria.)*

These two species of moths are very similar in appearance, both being wingless and depositing their eggs on almost any portion of the tree after crawling up the trunk. The larvæ are some of the so-called measuring worms, the spring species having only two pairs of prolegs while the fall species has three. Otherwise they are very similar. There is only one generation of each during the season. The spring

species winters over in the pupal stage in the soil while the fall species spends the winter on the trees in the egg stage. The fact that the female moths are wingless and can not fly into the trees makes it possible to control this pest perfectly by means of a band of some sticky preparation applied to the trunks. Arsenate of lead as used for the codling moth is of some value in controlling it. Black Leaf "40" at the strength of 1 part to 1000 parts of water has also been successfully used for both the spring and fall species.

#### **The Red-Humped Caterpillar.**

(*Schizura concinna*.)

The foliage of the apple is frequently attacked by communistic caterpillars, with red heads and large red humps on the first segment of the abdomen. Many prominent black spines along with this peculiar hump render the species very conspicuous. The adult is a brownish moth, which lays its eggs on the leaves. The winter is spent in the pupal stage in the ground.

Control measures consist of picking the caterpillars from the trees and spraying with arsenate of lead.

#### **Climbing Cutworms.**

Quite frequently in the early spring, buds of young apple trees are hollowed out by some species of climbing cutworm, of which there are several. This trouble is usually worse on sandy soil than on any other kind. Damage from this pest may be eliminated by means of cotton batting bands tied about the trees, over which the worms are unable to crawl. The method of using a cotton batting band is as follows: Take a band of the batting about three inches wide, and of sufficient length to go around the tree. After placing about the trunk, tie it near the bottom with a piece of twine, pulling the top portion downward, thus forming a collar which the worms do not penetrate. During the day time they may often be found in the soil near the crowns of the trees.

#### **Flat-Headed Apple-Tree Borer.**

(*Chrysobothris femorata*.)

Sun scalded or otherwise injured trees are liable to attack from this borer. The adult is a flat metallic colored beetle, which lays its eggs on the trees. Upon hatching from these eggs the footless larvæ, with body widened in front and tapering to the posterior extremity, feed in the sapwood, often completely girdling a tree. Quite frequently burrowing into the heartwood takes place.

There is no practical means of control. Preventive measures consist entirely of keeping trees in a thrifty growing condition.

#### **The Brown Mite.**

(*Bryobia pratensts*.)

While there are other mites that occasionally feed on apple foliage, this species is the one most commonly found. The little red eggs are deposited in the crotches and frequently about the buds of trees during the fall or late summer season. These remain unhatched throughout the winter. In the early spring, as the foliage begins to come out, the eggs hatch and the little mites, which are red at first, begin feeding

almost immediately. At this time they have only six legs, the fourth pair being developed as soon as they moult for the first time, and the color changes from red to greenish. There are several generations during the summer season, but usually the mites do not become abundant enough to seriously damage the apple trees.

Lime-sulphur, applied at the strength of 1 part to 10 parts of water, during the dormant season, just before the buds begin to swell, is an effective remedy. Either atomic or milled sulphur, during the summer season while feeding is going on, is also valuable in controlling it. Sulphur in any form is a good mite remedy as a general rule.

#### **Blister Mite.**

(*Eriophyes pyri*.)

While this is primarily a pear pest it is sometimes found injuring apple foliage, also, to a considerable extent. It may be recognized by the blister-like patches on the surface of the leaves. The winter season is spent under the bud scales of both apple and pear. In the early spring the mites leave their hibernating quarters, the females depositing eggs in the leaves, from which hatch the tiny larvæ, which immediately begin feeding and produce the characteristic appearance already mentioned. This pest may be controlled by an application of lime-sulphur just as the buds are beginning to open in the early spring.



## CHAPTER XV.

## DISEASES OF THE APPLE.

## BLIGHT.

*(Bacillus amylovorus)*

This disease affects some varieties of the apple as badly as it does the pear, and when trees in an orchard become affected the same remedial measures must be applied as in the case of the latter, viz, pruning out all diseased wood in roots, trunks and branches, being sure to cut well below where any signs of the disease are noticed; and carefully disinfecting all tools and cut surfaces with corrosive sublimate solution, 1 to 1000, *after every cut*.

## OAK ROOT FUNGUS.

*(Armillaria mellea.)*

Quite frequently apple trees are found rotted in the roots and at the crown by this serious disease. The writer has in mind one orchard visited early last spring, where tree after tree was diseased with this fungus. Oaks had been growing on the land previous to the time of apple tree planting and the stumps were still standing throughout the orchard in many places. Surrounding these stumps a number of trees were frequently found to be affected and great masses of toadstools, the fruiting bodies of the fungus, were growing about the stumps and apple trees. There is no cure known for this disease.

## APPLE SCAB.

*(Venturia inaequalis.)*

The very destructive and commonly distributed disease known as apple scab is familiar to practically every apple grower, and during certain seasons a heavy loss is sustained from it, if nothing in the way of spraying is done to control the fungus.

It has a preference for certain varieties, others being more or less resistant. The Yellow Newtown is one of the most susceptible to attack, and spraying of orchards consisting of this variety should never be neglected in sections where scab is prevalent. The Esopus is also very susceptible in California, as well as many other varieties that might be mentioned. Locality, of course, has considerable influence upon this trouble, and in general the high altitude orchards in California suffer most.

Fig. 49 illustrates the appearance of this disease as it occurs on the fruit, the well defined, grayish scabby patches, more or less roughened where the skin has been broken through, being characteristic of the advanced stage of the disease.

This disease is due to a fungous organism which winters on the tree and on fallen foliage. The plowing under of the leaves, before the spores have a chance to get into the trees in the spring, is one of the important things in connection with its control.

Spraying with some good fungicide must not be neglected. An early spring application of lime-sulphur at the dormant strength, or of Bordeaux mixture, applied as the buds are swelling, should be made. This should be followed by later applications, which may be combined with the arsenical sprays for codling moth, being careful that compatible mixtures are used. Either Bordeaux mixture or lime-sulphur with neutral arsenate of lead, according to Geo. P. Gray of the State University of California, may be safely used, or Bordeaux with either the acid or neutral arsenate of lead. Zinc arsenite should not be used with either Bordeaux or lime-sulphur.



FIG. 49.—Rhode Island Greening affected with apple scab. (Original)

### CROWN GALL.

(*Bacterium tumefaciens.*)

This is a very common disease of the apple, often found on nursery trees, and sometimes becoming so abundant that great numbers of them have to be destroyed. Trees with this disease, if planted in the orchard, may live for years, but are usually stunted and never develop into the best type of trees.

The cause of this affection is known to be a bacterium, which often enters through a wound, thus starting the disease, which manifests itself in swellings or galls. These occur on the crowns of trees, as well as the roots, at some distance from the crowns, and are very rarely seen above the ground.

There is no cure for crown gall, but preventive measures, such as inspection and destruction of all affected nursery trees, may keep it out of the orchard.

**POWDERY MILDEW OF THE APPLE.***(Podosphæra leucotricha and P. oxycanthæ.)*

The above disease and scab are the two worst fungous troubles of the apple that occur in California. Mildew attacks the leaves and tender twigs and is recognized by a whitish powdery appearance of the twigs,

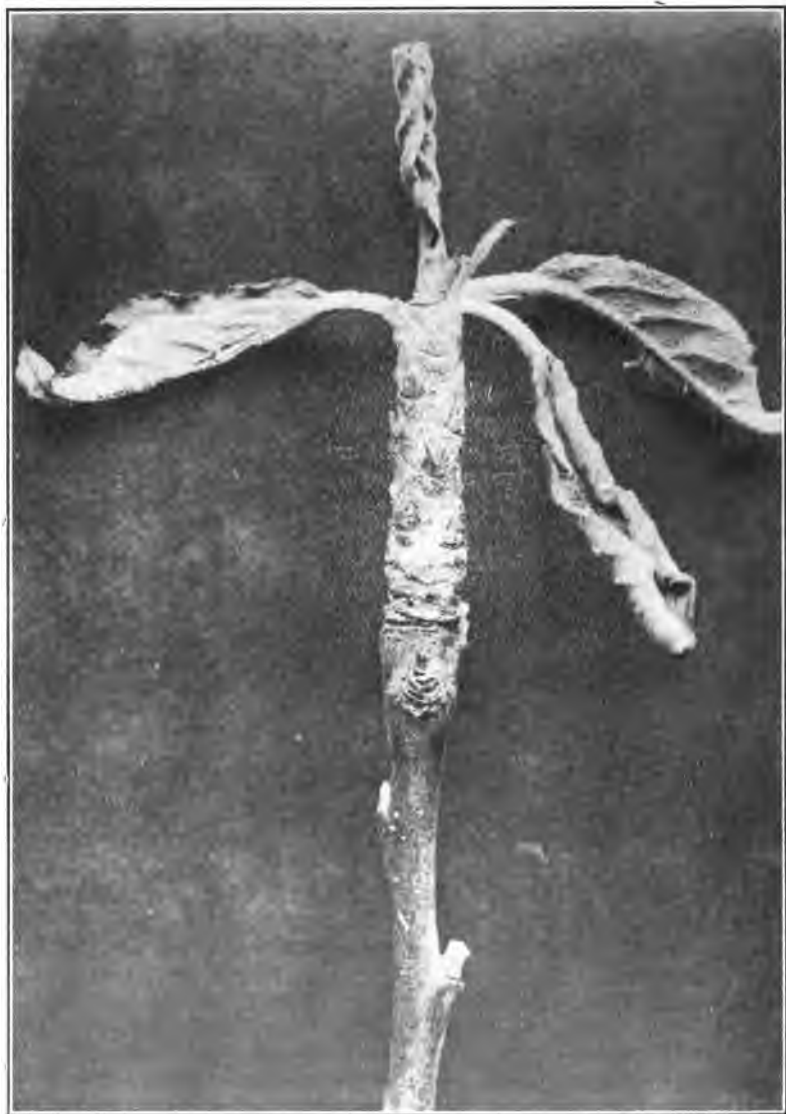


Fig. 50.—Apple twig affected with mildew, showing characteristic appearance.  
(After R. E. and Elizabeth H. Smith)

both in the summer and winter seasons. There is also more or less curling of the leaves. According to Bulletin No. 120, recently published by W. S. Ballard of the Bureau of Plant Industry and W. H. Volck,

County Commissioner of Santa Cruz County, the winter is spent both in dormant buds and as spores in black patches on the twigs. The disease may be started in the spring from the fungus in the dormant buds or from these black patches on the twigs, the former being the common source of infestation in the Pajaro Valley. The climatic conditions of that section are said to favor very greatly the development of the disease. At high altitudes, wherever apples are grown, serious infestations have been found. Here again moisture conditions are such as to aggravate the trouble. The authors of the previously mentioned bulletin recommend finely divided sulphur in some form as the very best mildew fungicide. Ordinary flowers of sulphur is not fine enough for good results. The following instructions and formula are copied from their bulletin and this formula has given general satisfaction wherever it has been tested out:

#### Preparation of the Iron-Sulphid Mixture.

The following directions are for the preparation of sufficient stock iron-sulphid mixture to make 500 gallons of spray: Fill a 50-gallon barrel about two thirds full of water. Weigh out 10 pounds of iron sulphate (copperas), place in a sack, and suspend in the water. The iron sulphate will dissolve fairly rapidly, and when it is all in solution measure out carefully  $2\frac{1}{2}$  gallons of commercial lime-sulphur solution testing 33° Baumé, or 2 gallons and 3 pints of a lime-sulphur solution testing 32° Baumé. Slowly pour all but 2 pints of the lime-sulphur solution into the iron-sulphate solution in the barrel, stirring the mixture vigorously with a hoe or shovel. The addition of the lime-sulphur solution will produce a bulky, black precipitate, and when all but 2 pints of the lime-sulphur solution has been added the mixture should be allowed to stand for a few minutes, when the black precipitate will begin to settle and a little of the clear liquid at the top can be carefully dipped out with a clean glass or cup. This clear liquid will probably show no yellow lime-sulphur color, which means that an excess of lime-sulphur solution has not yet been added. In other words, there is still some iron sulphate in solution, in which case the addition of a drop of lime-sulphur solution to the clear liquid in the glass will produce a black precipitate. This means that more lime-sulphur solution should be added to the stock in the barrel, and about half of the remaining 2 pints should now be poured in and the contents of the barrel stirred vigorously and allowed to stand. Some of the clear liquid should again be dipped off and tested as before, to determine whether an excess of lime-sulphur solution has been added. If necessary, the addition of small quantities of lime-sulphur solution should be continued until some of the clear liquid dipped from the top, after the contents of the barrel have been well stirred and allowed to settle, shows a pale yellowish lime-sulphur tint. The purpose of using a slight excess of the lime-sulphur solution is to insure all the iron sulphate being utilized. The voluminous black precipitate that is formed consists of iron sulphid, precipitated sulphur, and calcium sulphate. After a slight excess of lime-sulphur solution has been added, the barrel should be filled with water and the contents stirred thoroughly and allowed to stand for several hours. The black iron-sulphid mixture will settle into the lower half or third of the barrel, and the clear liquid should be poured off by carefully and gradually tipping the barrel, without allowing any of the black precipitate to run out. The barrel should again be filled with water, the contents thoroughly stirred and allowed to stand several hours, and the clear liquid poured off as before. This operation of washing the precipitate should be repeated until the water poured off no longer shows the yellow lime-sulphur tinge. Probably three or more such washings will be required, depending upon how careful the operator has been in using only a slight excess of lime-sulphur solution.

It is evident that the preparation of this stock supply should be commenced two or three days before the spraying is to be done, but when once prepared it may be kept indefinitely. If care is used in weighing out each lot of iron sulphate and if the lime-sulphur solution used is accurately measured there will be no trouble in making

up the stock supplies rapidly after the first two or three batches have been prepared, and it will be remembered that each batch is sufficient for making 500 gallons of spray mixture. In order to keep a supply of the stock mixture on hand, several batches should be prepared before the spraying commences, and as rapidly as a barrel is emptied the preparation of a new batch should be started. Iron sulphate is comparatively cheap, and the entire cost of materials for preparing 100 gallons of the mildew spray, when diluted according to the recommendations given in this bulletin, should not exceed 15 or 20 cents.

When the washing has been completed, the stock barrel should be filled with water to exactly 50 gallons. The material is now ready for use as directed under "General formula for the spray mixture," but care should be taken to stir the contents of the barrel thoroughly each time before any of the mixture is taken out.

#### General Formula for the Spray Mixture.

*Stock iron-sulphid mixture*----- 20 gallons  
*Arsenicals and nicotine solution to be added as required.*  
*Water, to make*----- 200 gallons

When arsenicals and a nicotine solution are to be used in conjunction with the iron-sulphid mixture, the combined spray may be prepared by first running about 150 or 160 gallons of water into the spray tank. The agitator is then started and the 20 gallons of stock iron-sulphid mixture is poured in, after which the nicotine solution and the arsenicals may be added in the usual way. Sufficient water should then be added to make 200 gallons.

This same strength of iron-sulphid mixture, namely, 20 gallons in 200 gallons of spray, is to be used in all the mildew applications. It will be seen that the 20 gallons of stock mixture used in each 200 gallons of spray contains the product from 4 pounds of iron sulphate.

There are other products besides iron-sulphid which contain sulphur in a very finely divided form that can be used just as effectively in the control of mildew. The California Spray Chemical Company at Watsonville is supplying a form known as "Milled Sulphur," and both the General Chemical Company and Balfour, Guthrie & Co., of San Francisco, sell another product under the trade name of "Atomic Sulphur." No doubt there are still other forms that could be used to good advantage, the essential qualifications being the finely divided state of the sulphur, as has already been indicated.

As is true with most diseases of this nature, a thrifty, strong growing tree is apt to resist attacks to a greater or less extent. Consequently, it is very desirable that everything be done toward keeping orchards in the best possible condition. Thus fertilization may be a great benefit, and Ballard and Volck recommend spraying during the early spring with a crude oil emulsion, which has a tendency to stimulate growth. Pruning is an important means of checking this disease. All infested twigs which are noticed during the time of pruning, either in the dormant or summer season, should be cut from the trees.

## CHAPTER XVI.

## PICKING, GRADING AND PACKING.

## PICKING.

The knowledge that has been acquired in regard to the various organisms which produce decay in fruits, and that many gain entrance only where the skin is broken by bruising or where a worm has entered, has resulted in much greater care being taken, when picking apples, than formerly. How well can we all remember the time when the apples high up in the trees were shaken to the ground or knocked down with a pole regardless of the injury done to them in falling. It is now known that only the sound apples will keep well when packed, and even slight bruises will act as starting points for decay and the ruination of the fruit. As a consequence, picking is done with the greatest care by the

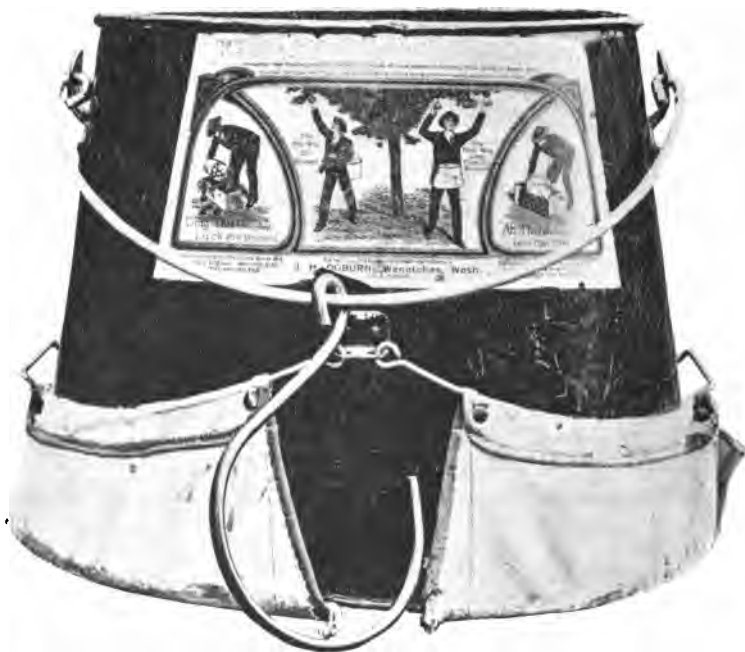


Fig. 51.—A good type of picking bucket. (Original)

better orchardists and the handling of the fruit is done as carefully as though one were handling eggs. As far as possible all stems should remain intact after fruit is picked.

When pulled from the trees the apples should be carefully placed in the picking bag. Careless dropping of the fruit into the bags may result in many bruises, and again when emptying from the bag into a box, care should be exercised so that they are not allowed to drop too far. The type of picking bucket shown in Fig. 51 has a canvas bottom which opens when being unhooked at the side, and the apples are emptied

into the box without danger of bruising, provided that the picking vessel is not held too high when opened. There are a number of good picking bags made somewhat like the one shown in the picture, any of which will give good service, providing that they are used by careful pickers. Common buckets of small size are sometimes used and are quite satisfactory, but are not so conveniently emptied as vessels with the collapsible bottoms.

#### GRADING.

The grading of apples is usually done in the packing-houses. Fig. 52 shows boxes of apples in house awaiting this work, which is sometimes



Fig. 52.—Boxes of fruit in the packing-house ready for grading. (Photo by C. B. Weeks)

done by means of mechanical graders, of which there are a number of different types on the market. Some of these are said to be very satisfactory, while others are apt to bruise the fruit more or less, thus bringing about decay prematurely. Ordinarily such work is done by hand. The beginner is given a board in which holes of different sizes, representing the diameters of the apples that are used in the different styles of pack, are made. These are used simply to train the eye to the various sizes, and are not necessary after one has been doing the work for a short time. All cull apples are removed during the process of grading; that is, such as are stemless, contain worms, worm holes, bruises, limb scars, etc. When mechanical graders are used, all blemished fruit must be picked out by hand, either before or after it has been put through the grader.

## PACKING.

What we might term the evolution of the apple pack has been very marked in the past quarter century. We can all remember the time when no attempt was made at grading, small apples and big apples being put into the same package, usually the former on the bottom; indeed, sometimes no attempt was made to keep varieties separate and several kinds were placed in the sack, box or barrel and sold together. The West, with its cooperative marketing organizations, has undoubtedly done more toward developing a uniform pack and establishing a fancy trade than the rest of the United States. The East, until very recent years, has insisted on putting apples in barrels and, while standardization of the barrel pack could be accomplished as well as of the box pack, the East has been slower in evolving along these lines, and has of recent years been copying after the West, until now apples are often packed in boxes and marketing agencies with their standardized packs are competing with our western organizations.

The boxes that are being used at the present time are variable in size. California uses a box that is  $9\frac{1}{2}$  by 11 by 22 inches; Oregon and Colorado have boxes of the following dimensions, respectively:  $10\frac{1}{2}$  by



Fig. 53.—Yellow Bellflowers, illustrating  $3\frac{1}{2}$ , 4 and  $4\frac{1}{2}$  tier packs. (Original)

$11\frac{1}{2}$  by 18 inches and  $11\frac{1}{2}$  by  $11\frac{1}{2}$  by 18 inches. A bill, designed to create a standard size and pack, was introduced into the session of Congress just closed by Judge J. S. Raker, but failed to pass. With California using one sized box principally, Oregon another and Colorado still another, it is found to be a difficult matter to agree on a standard, but as standardization in the matter of packages for all fruits is becoming necessary for uniformly good sales, the time will come, no doubt, when the West will agree on a certain sized box to be used and marked as standard.

In the Watsonville section of California, where a splendid pack on the whole is made, there are three packs known as  $3\frac{1}{2}$ , 4 and  $4\frac{1}{2}$  tier, with the 4 tier as the standard, or average size, which is most desirable to the trade in general. This size varies from  $2\frac{5}{8}$  inches as a minimum to  $3\frac{1}{4}$  inches as a maximum. The  $3\frac{1}{2}$  tier size contains apples over  $3\frac{1}{4}$  inches in diameter, and the  $4\frac{1}{2}$  smaller apples than  $2\frac{5}{8}$ . These rules are for their standard varieties: Yellow Newtown and Yellow Bellflower.

In the case of the  $3\frac{1}{2}$  and 4 tier apples, the fruit is always wrapped by the packers. This practice is one of tremendous value and should be



followed by every section where apples are produced commercially. Such wrapping not only facilitates the work of packing, but enables one to put up a much firmer pack and one less subject to bruising in boxing and during transportation than could otherwise be possible. The keeping qualities of the fruit are no doubt enhanced to a marked degree. Tasteful designs or trade marks may be placed on these wrappers, as well as the name of grower and locality, thus adding greatly to the attractiveness of the pack.

Fig. 53 shows three boxes of excellent Yellow Bellflowers grown and packed by Rodgers Bros. of Watsonville. This picture illustrates nicely the diagonal pack and shows the three sizes, viz:  $3\frac{1}{2}$ , 4 and  $4\frac{1}{2}$  tier.

The pack, when made, should be so firm that each apple is held fast by another, and none have any room for play. When covered and

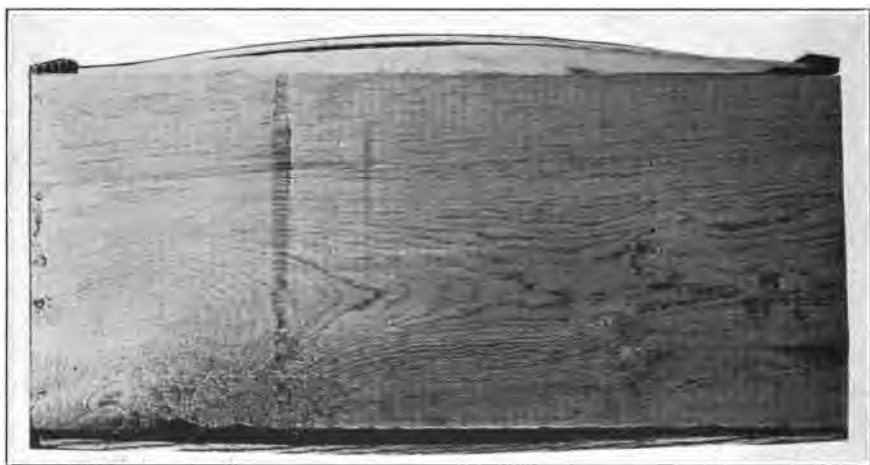


Fig. 54.—A well packed box of apples with a top bulge of  $\frac{3}{4}$  inch. (Original)

nailed there should be a bulge of at least  $\frac{3}{4}$  inch on the top and a slightly lesser amount on the bottom. (See Fig. 54.)

Tasty lithographed labels of various designs are used on the ends of boxes, and such should result in the best kind of advertising for the grower. When the trade learns a label and knows that the man who uses it always exercises the greatest care in packing his fruit, it may be the means of securing for him a good market. On the other hand, such labels may have the opposite tendency and work injury to the man who persists in packing undesirable fruit and misrepresenting it by the label.

#### Special Packages.

While practically all of the fancy California apples are wrapped and packed in two sized boxes, viz: the California box and the Oregon box, there is a certain limited demand, at least, for a smaller package, such

as a person could easily carry away from a grocery store. Recognizing this demand, Mr. J. F. Benton of Arcata has been packing apples in cartons which hold just one third of a box. Figs. 55 and 56 show one of his special cartons packed and ready to seal, and the other sealed. It is probable that large growers close to market would not be justified



Fig. 55.—Carton used by J. F. Benton of Arcata, which holds one third of a box of apples.

in making such a pack, but on the other hand the grower with a small orchard, located at a distance from market, might be able to secure a limited fancy trade by packing only the very finest apples in such packages as these. Mr. Benton secures his own market and deserves success in his new venture.

## CHAPTER XVII.

## BY-PRODUCTS.

No matter how carefully an orchard may be sprayed and cared for in general, there is always a considerable loss of fruit because of wind-falls, undersized apples, limb bruises, sunburn, etc. Such fruit is not fit to pack and while sometimes the temptation is very strong to put it in boxes and market it, yet the prices received are seldom such as to justify



Fig. 56.—The same carton as shown in Fig. 55, after it has been sealed.

the practice. The utilization of all such fruit which, if boxed, brings nothing, and if left in the orchard ordinarily goes to waste, is one of our important problems.

There are many by-products of the apple for which great demand could be created. Some of these are jelly, cider, vinegar, apple butter, dried apples, etc. The drying business has reached quite extensive proportions in the Pajaro Valley.

As an assistant judge at the California Apple Show held at Watsonville in 1913, the writer had the pleasure of helping with the awarding of the first premium for feature exhibits to Mrs. Hugh

McGowan, who had constructed with jelly glasses, all full of pure apple jelly of different shades of coloring, a building which was an exact reproduction of the great Watsonville auditorium where the show was held. The dimensions of this auditorium made of jelly were as follows: length, 15½ feet; width, 10 feet; height, about 4 feet.

This season such a building was constructed at the California Apple Show held in San Francisco and was again recognized by the judges by being awarded third premium for feature exhibits. Fig. 57 shows this excellent exhibit. Mrs. McGowan certainly deserves much credit and the thanks of the community in which she lives for her energy in making such a tremendous quantity of jelly and in putting up such an exhibit as the one mentioned. It is hard to foresee what the development of this one industry may mean to the Watsonville section. This is just an illustration of the great possibilities that there are for those who will take advantage of them.

Recently while visiting some of the fruit orchards in the Julian section of San Diego County—which is not easily accessible—the writer was

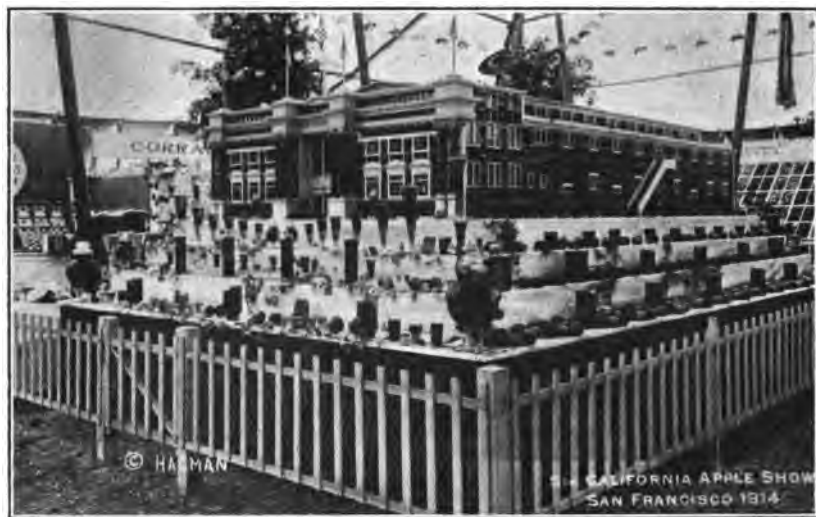


Fig. 57.—Model of the Watsonville Auditorium made from glasses filled with pure apple jelly. Exhibited by Mrs. Hugh McGowan at the Annual Apple Show in San Francisco.

pleased to find an up to date plant, on the ranch belonging to S. A. Walters, for the manufacture of apple butter, cider, vinegar and other by-products. Mr. Walters has undoubtedly solved the problem of getting good returns for his fruit. While it might be easy to overdo the manufacture of some of these by-products, yet it would seem that there are great possibilities, particularly for orchardists who are a long way from market and who have no provision for storing their fruit. As has already been mentioned, one of the chief reasons for manufacturing by-products is that there is ordinarily a great waste of imperfect fruit. The aim should always be to grow the best possible apples which may be packed and sold, most seasons, to good advantage. There will, however, come seasons of low prices when even the very best can be utilized in the manufacture of such by-products as seem best, and in this way a good market will be insured.

## CHAPTER XVIII.

## PRODUCTION, CONSUMPTION AND RECIPES.

Statistics show that the acreage of apples has been greatly increased in the past few years, which, of course, means a corresponding increase in the production. The East is also awakening to the possibilities in apple growing, and where thousands of acres of this fruit were destroyed by San José scale not many years ago, new orchards are being set out and the West must be prepared to meet this competition.

It has already been stated that the apple crop varies in size from season to season, largely on account of killing spring frosts in different parts of the country. This variation in size means a fluctuation in prices, which range from very high in one season to very low in another. During seasons of light crops the marketing problem solves itself, but during seasons of very heavy crops there is always danger of prices being so low as to make apple growing unprofitable. It is this fact that should make us bend every effort toward increasing the consumption of apples, in order to lessen the possibility of overproduction and consequent low prices for our fruit.

We are abundantly justified in any campaign that may be carried on with the aim of increasing consumption, because of the excellent food value of the apple. Much has been done in the past few years to educate the people along this line. The splendid apple shows that have been held in different parts of the country have taken a leading part in this work. In our own state the great California apple show—which is usually held annually at Watsonville, but this year at San Francisco—and the annual Sebastopol Gravenstein show, have advertised in an emphatic way the value of the apple as food. Who could look at a tasty jelly exhibit, such as Mrs. McGowan's, shown in Fig. 57, without having a better taste created for apple jelly? Or who could look at the splendid exhibits of Gravensteins at the Sebastopol show (Fig. 58) without going away feeling that he must buy a box of Gravensteins when he gets home?

Our fruit journals have also done much toward increasing the consumption of this, the best of all fruits. In 1912 the October number of "Better Fruit," published at Hood River, Oregon, printed a list of 209 ways for cooking the apple. These recipes were gathered by L. Gertrude Mackay, of the domestic science department, Pullman, Washington. With the help of Mrs. Weldon 50 of these have been selected and are here printed, in hopes that they may reach many housewives of California, who will be encouraged to try them and cook more apples than they otherwise would, thus aiding in the work of increasing the consumption.



Fig. 58.—Feature exhibit at Gravenstein Apple Show, Sebastopol, 1913. (Original)

## RECIPES.

1. *Baked Apples*.—Peel and core tart apples; fill the holes with shredded citron, raisins, sugar and a little lemon peel. Place in baking dish and pour over them one half cup of water and dust with granulated sugar. Bake in a slow oven until perfectly tender and sprinkle with soft bread crumbs and sugar; bake for ten minutes and serve hot with cream or pudding sauce.

2. *Apple Fritters, English Style*.—Beat one egg, add a few grains of salt and one fourth cup of milk; cut out four rounds of bread from half inch slices of stale bread; set the bread into the milk and egg mixture and cook in deep fat.

Stew apples, pared and cored, in a few spoonfuls of syrup. Place an apple on each round of bread and grate a little nutmeg over the top. Serve very hot.

3. *Afterthought*.—One pint of nice apple sauce sweetened to taste; stir in the yolks of two eggs well beaten. Bake for fifteen minutes. Cover with a meringue made of two well beaten whites and one half cup of powdered sugar. Return to the oven and brown.

4. *Apricot Sherbet Served in Apple Shells*.—Select bright red apples of uniform size, rub until they have a high polish. Cut off the blossom end and scoop out the pulp; carefully notch the edge. Fill with apricot sherbet and serve upon apple leaves.

5. *Apple Balls with a Mixture of Fruit*.—Peel large apples, with a potato scoop cut out small balls, dropping them into water with a little vinegar added to keep them white. Prepare a mixture of grapefruit pulp, pineapple and banana and put into glasses; add a few of the apple balls, pour over all the juice left from the fruit which has been boiled down with sugar; cool and serve at once or the apples may turn brown.

6. *Apple Balls Served in Syrup*.—Prepare the apple balls as above; prepare a rich sugar syrup; color with a little pink color paste and drop in the balls, cook slowly until the balls are softened, pile in glasses and add a little syrup to each glass. Serve cold.

7. *Brown Betty*.—Pare and chop six apples; place a layer of apple in a well buttered pudding dish, then a layer of bread crumbs, sprinkle with brown sugar and cinnamon, repeat until the dish is full; add several generous lumps of butter and pour sweet milk or hot water on until it comes within an inch of the top of the pan. Bake in a moderate oven until brown and serve with plain or whipped cream.

8. *Apple Butter*.—Pare, core and quarter the desired quantity of apples, allowing one third of sweet to two thirds of sour apples. Boil sweet cider until it is reduced one half. While the cider is boiling rapidly add apples until the mixture is the desired thickness. Cook slowly, stirring constantly and skimming when necessary. When the apples begin to separate from the cider take two pounds of sugar to each bushel of apples used; add a little ground cinnamon and boil until it remains in a smooth mass, when a little is cooled. Usually one and one half bushels of apples are enough for one and one half gallons of boiled cider.

9. *Apple Biscuit*.—To one pint of light bread sponge add one quarter cup of molasses, one teaspoonful of lard and graham or whole wheat flour for a soft dough. Beat vigorously and finally work into the dough one large cup of chopped apple; shape the dough into biscuit and place in muffin pans and allow them to be very light before baking.

10. *Dried Apple Butter*.—Wash one pound of dried or evaporated apples thoroughly, soak over night; in the morning cook with plenty of water. When well done rub through a sieve or colander; add sugar and cinnamon to taste, the juice of one lemon, juice of two oranges and butter the size of an egg. Cook slowly until it will drop heavily from a spoon.

11. *Apples En Casserole*.—Pare, core and slice two quarts of apples and put in an earthen dish, alternately, with one and one half cups of sugar; add one fourth cup of cold water, cover the dish and bake in a moderate oven. Serve either hot or cold with cream.

12. *Apple Charlotte, I*.—Soak one half a box of granulated gelatine in one half cup of cold water for half an hour. Whip one pint of cream and set on ice; add one half cup of powdered sugar, a tablespoonful of lemon juice and two good sized apples, grated. Dissolve the gelatine over hot water and strain into the mixture; stir quickly and pour into a mould. Set on ice to chill and serve.

13. *Apple Charlotte, II*.—Pare, core and slice apples; cook in butter until soft and dry; add sugar to taste. Line a plain mould with sippets of bread an inch wide, dipped in melted butter; let one overlap the other; arrange lozenges of bread similarly in the bottom of the mould. Fill the center with the apple and cover the top with bread. Bake for half an hour in a hot oven. Serve with cream and sugar or a hot sauce.

14. *Plain Apple Charlotte*.—Soak one quarter of a box of granulated gelatine in two tablespoonfuls of cold water; add to one pint of hot apple sauce, flavor and press through a sieve. As soon as the mixture begins to harden stir in one pint of whipped cream. Line a mould with ladyfingers, pour in the mixture and set away to cool.

15. *Apple Cobbler*.—Pare and quarter enough tart apples to fill a baking dish three fourths full. Cover with a rich baking powder biscuit dough made soft enough to stir, spread it over the apples without rolling. Make several cuts in the center to allow the steam to escape. Bake for three quarters of an hour and serve hot with sugar and rich cream.

16. *Coddled Apples*.—Take tart, ripe apples of uniform size; remove the cores. Place the fruit in the bottom of a porcelain kettle, spread thickly with sugar; cover the bottom of the kettle with water and allow the apples to simmer until tender. Pour the syrup over the apples and serve cold.

17. *Apple Conserve*.—For each pound of quartered and pared apples allow three quarters of a pound of sugar and half a pint of water. Boil sugar and water until a rich syrup is formed; add the apples and simmer until clear. Take up carefully, lay on plates and dry in the sun. Roll in sugar and pack in tin boxes lined with waxed paper.

18. *Compote of Apples*.—One pound of apples, one quarter pound of lump sugar, one cup of water, the juice of half a lemon, a few drops of red coloring. Put the sugar, water and lemon juice into a clean enameled sauce pan and let them boil quickly for ten minutes. Meanwhile peel the apples, cut them in quarters and remove the cores. Throw the pieces into the boiling syrup and let them cook slowly until clear and tender, but not broken. Then remove the quarters of apples carefully, reduce the syrup a little and color it pink with the red coloring. Arrange the apples on a glass dish and pour the syrup over. A little cream or custard served with the compote is a great improvement. If the apples are small they may be cored and cooked whole.

19. *Apple Compote and Orange Marmalade*.—Boil twelve tart apples in one quart of water until tender, strain through a jelly bag; add one pound of granulated sugar and let boil. While boiling add twelve apples, cored and pared. When the apples are tender drain them carefully in a perforated skimmer. Boil the syrup until it jells; fill the apples with orange marmalade and pour the syrup over them. Serve with whipped cream.



20. *Crab Apple Marmalade*.—Wash and core crab apples and put them through the meat chopper. Put into a preserving kettle and add water until it shows through the top layer of apples. Cook until soft. Weigh and add an equal weight of sugar. Cook until the mixture forms a jelly when cooled and pour into sterilized glasses. Cover with paraffine.

21. *Apple Custard*.—Beat the yolks of four eggs and add one half cup of sugar; cook for one or two minutes and remove from the fire. Gradually add one pint of grated apple. Pour into a serving dish and cover with a meringue made of the well beaten whites of four eggs and three tablespoonfuls of powdered sugar.

22. *Apple Cup Custard*.—Pare, core and steam four good sized tart apples until tender; press through a sieve. While hot add one tablespoonful of butter, four tablespoonfuls of sugar, the yolks of four eggs and one half pint of milk. Turn into baking cups and bake for twenty minutes. Beat the whites of four eggs until stiff, add four tablespoonfuls of sugar, beat and heap over the top of the cups; dust thickly with powdered sugar and brown in the oven. Serve cold.

23. *Apple Custards*.—Steam two large tart apples that have been peeled and cored. Rub them through a sieve and add one cupful of milk, two teaspoonfuls of butter, one quarter of a cupful of sugar and the yolks of four eggs. Turn the mixture into baking cups, stand them in hot water and bake about twenty minutes. When they come from the oven pile the beaten white of egg on top of each cup, sprinkle with powdered sugar and place in the oven to brown slightly. Serve cold.

24. *Apple Croquettes*.—Pare, quarter and core enough tart apples to make a pint; place in a saucepan with one small tablespoonful of butter and, if the apples are not juicy, a few tablespoonfuls of water. Cover and stew gently until tender, then press through a sieve. Return to the fire and add sugar. Add one tablespoonful of corn-starch and one quarter of a teaspoonful of salt, mix to a thin paste with cold water; stir until thickened, cover and cook slowly for fifteen minutes. Turn out on a greased dish and set away until cold. Form into tiny croquettes, roll in bread crumbs, dip in lightly beaten egg, then roll again in crumbs and fry in deep fat; drain on unglazed paper and serve with roast pork or roast goose.

25. *Delmonico Apples*.—Put a layer of apple sauce in a buttered pudding dish, sprinkle with ground almonds, dot with butter and sprinkle with crushed macaroons, add a little water and bake. Delicious when served with meat.

26. *Apple Delight*.—Put a layer of apple sauce in a buttered pudding dish, dot with butter, add a layer of chopped peaches and apricots, sprinkle with blanched almonds, ground rather coarsely; repeat until pan is full; pour the peach juice over the mixture and bake for one hour. Serve as a relish with meat course.

27. *East India Chutney* (Apple).—Pare and core twelve sour apples. Peel one medium sized onion. Remove seeds and stems from three peppers, one of which should be red. Chop apples, peppers, onion and one cup of raisins very fine; add the juice of four lemons, one pint of cider vinegar and half a cup of currant jelly; let simmer very gently for one hour, stirring frequently. Add one pint of cider vinegar, two cups of sugar, one tablespoonful each of salt and ground ginger and one fourth of a teaspoonful of cayenne; cook for one hour more, stirring constantly. Store as canned fruit.

28. *Apple Farci*.—Choose tart red apples, Northern Spys if possible; wash, wipe and core. Do not pare. With the corer remove apple in three places, equally distant from stem and blossom end, holding corer in oblique position and pressing downward toward center. Fill these cavities with raisins, dates or figs, sugar, cinnamon. Canned or fresh pineapple is delicious filling. Always use raisins, placing them in the cavities first to prevent the other filling from slipping through. After filling place the apples in a pan that has been sprinkled with sugar and cinnamon. Sprinkle

each apple with sugar and cinnamon. Place in a hot oven until the sugar melts, then add one fourth cup of water or fruit juice and bake until tender. Baste frequently with the syrup. Serve either hot or cold with whipped cream sprinkled with cocoa.

29. *Apples Fried with Onions*.—Peel onions and slice. Fry in fat until a rich brown; drain on soft brown paper. Fry unpared quarters of apple in the fat left from the onions. Arrange apples in a border on a platter, fill center with the fried onions and serve them hot.

30. *Fried Apples*.—Quarter and core five apples without paring. Put into a frying pan and melt beef drippings; when hot lay a layer of apples in it, skin side down, sprinkle with brown sugar, and when nearly done turn and brown; place on a platter and sprinkle with sugar; set in hot oven and continue frying apples one layer at a time.

31. *Apple Fritters, I*.—Mix and sift one and one third cups of flour, two teaspoonfuls of baking powder and one fourth teaspoonful of salt. Add gradually, while stirring constantly, two thirds of a cup of milk and one egg well beaten. Wipe, core, pare and cut two medium sized sour apples into eighths, then slice the eighths and stir into the batter. Drop by the spoonful into hot deep fat and fry until delicately browned; drain on brown paper and sprinkle with powdered sugar.

32. *Apple Fritters, II*.—Pare and core four tart apples and cut in one fourth inch slices across the apple. Sprinkle with two tablespoonfuls of lemon juice and powdered sugar. Prepare a batter by sifting one cup of flour and one fourth teaspoonful of salt. Add two well beaten yolks to one half cup of milk; mix and beat into the flour until smooth. Add one tablespoonful of melted butter or olive oil and cut in the well beaten whites of two eggs. Drain the apples, dip into the batter and fry in deep fat. When cooked drain on brown paper and sprinkle with powdered sugar before serving.

33. *Oxford Apples*.—Pare, core and quarter four large tart apples and boil in very little water. Mash and add one tablespoonful of butter, half a cup of sugar, half a cup of fine bread crumbs, the yolks of four eggs and the whites of two eggs beaten light. Pour into a baking dish and cover with a meringue made of the whites of two eggs and two tablespoonfuls of powdered sugar and brown.

34. *Apples with Oatmeal*.—Core apples, leaving large cavities, pare and cook in a syrup made by boiling one cup of sugar with one and one half cups of water for five minutes. When the apples are soft drain and fill cavities with the hot, well cooked meal and serve with cream and sugar.

35. *Sausages and Fried Apples*.—Prick the sausages well with a fork. Place in a deep frying pan, pour in enough boiling water to cover the bottom, cover and cook over a moderate fire. When the water evaporates remove the cover and turn several times that they may be nicely browned. Turn on to a platter. Core a number of large tart apples, cut them in rings an inch thick and fry in the sausage fat. Garnish the sausage with the apples and serve.

36. *Apple Tapioca*.—Soak three fourths of a cup of tapioca in water for one hour to cover, drain, add two and one half cups of boiling water and one half teaspoonful of salt; cook in double boiler until transparent. Core and pare apples, arrange in a buttered baking dish, fill cavities with sugar, pour tapioca over apples and bake in a moderate oven until the apples are soft. Serve with sugar and cream or with cream sauce. Sago may be used instead of tapioca.

**CREAM SAUCE.** Mix and beat until stiff three fourths of a cup of thick cream and one fourth of a cup of milk, add one third of a cup of powdered sugar and one half teaspoonful of vanilla.

37. *Apple Water*.—Wipe, core and pare one large sour apple, put two teaspoonfuls of sugar in the cavity; bake until tender, mash, pour one cup of boiling water over it and let stand one half hour and strain. This is especially refreshing for fever patients.

38. *Apple Christmas Pudding*.—Pare, core and quarter six tart apples. Add a cup of water, cover and boil quickly for five minutes. Press through a sieve; add a tablespoonful of butter and a cup of sugar. Beat three eggs until light; add one pint of milk and a cup of hot boiled rice. Add the apples and bake for half an hour. Lemon and orange rind may be added. Serve cold with cream or lemon sauce.

39. *Apple Sauce Pudding*.—Cream one quarter cup of butter with one half cup of brown sugar; add one beaten egg, two tablespoonfuls of milk, one half teaspoonful of baking powder and enough flour to make a stiff batter. Bake in two layers, put together while hot with apple sauce and serve with custard.

40. *Apples Baked in Strawberry Jam*.—Core tart apples and place in a baking dish; fill the cavities with strawberry jam and bake until soft. Serve hot with cream.

41. *English Apple Pie*.—Butter a shallow agate dish. Select one that is deeper than a pie plate. Fill the dish with sliced apples, sprinkle with a cup of sugar, half a teaspoonful of salt and a little nutmeg. Put over it two teaspoonfuls of butter in bits; add three tablespoonfuls of cold water. Cover with good paste and bake for forty minutes. Serve with cream.

42. *Pot Apple Pie*.—Peel and quarter eight nice tart apples (Greenings are the best), and slice in strips about half a pound of fat salt pork and mix a nice light biscuit dough. Then take an iron kettle and lay strips of the pork across the bottom about half an inch apart, then lay on that loosely some of the quartered apples, then sugar and cinnamon, then slice your biscuit dough in strips about the same as the pork and crosswise, leaving about an inch between each strip. Repeat this operation until you have used up your material, having the biscuit dough on top; then pour down the side of the kettle carefully a cup of boiling water, cover and cook slowly for one hour and a half, adding boiling water when necessary. This is delicious when served with whipped cream.

43. *Apple Pie Decorated with Cream and Cheese*.—Make an apple pie after your favorite recipe. Have ready a cream cheese, press through a ricer, cut and fold into the cheese a cup of double cream beaten until solid; add a few grains of salt. Put this mixture through a pastry tube, in any pattern, on top of the pie. Serve as a dessert at either luncheon or dinner.

44. *Date and Apple Pie*.—Line a pie plate with a rather rich crust; fill it with a mixture of chopped dates and apples, sprinkle over half a cup of sugar and one teaspoonful of cinnamon; add two tablespoonfuls of water, cover with a top crust and bake about one half hour in a moderate oven.

45. *Apple Peanut Salad*.—Pare, core and chop slightly acid apples and mix them with half as much chopped celery. Mix a dressing of peanut butter, using five tablespoonfuls of lemon juice to one tablespoonful of peanut butter. Mix dressing through the apples and celery and season with salt and cayenne pepper. Chill the salad and serve on lettuce and garnish with peanuts.

46. *Apple, Orange and Peach Salad*.—Equal parts of apples, peaches and oranges are cut into cubes and mixed with cream dressing. Serve in apple shells or in the rind of oranges.

47. *Apple Chicken Salad*.—Take six ripe apples and scoop out the centers; fill them with cold cooked chicken, minced fine, seasoned with finely minced green peppers and salt, with enough cream to moisten. Place apples in a steamer and cook until almost tender. Put them on ice and serve with mayonnaise on lettuce.

48. *Apple Salad*.—Chop one half pound of cold veal or lean pork and two large tart apples; add two chopped pickles, one tablespoonful of olive oil, one tablespoonful of vinegar, season with salt and pepper and mix with mayonnaise dressing.

49. *Apple and Cabbage Salad*.—Shave cabbage fine and soak for one hour in celery water, made by adding one teaspoonful of celery salt to each quart of water. Drain and dry on a soft towel. Add an equal amount of apple cut into match-like pieces; mix with boiled dressing.

50. *Apple and Cheese Salad*.—Mix some chopped pecans with twice their bulk of cream cheese, adding a little thick cream to blend the mixture. Season with pepper and salt and make into tiny balls. Pare mellow, tart apples, core and slice across the center into rings about one half inch thick, then arrange rings on lettuce leaves and place several cheese balls in the center. Serve with cream salad dressing.

## CHAPTER XIX.

## INSECTICIDES AND FUNGICIDES.

In spraying the apple for the control of the various insect pests and fungous diseases that affect this fruit, there are many different formulæ used, the principal of which are given herewith, under the headings Contact Insecticides, Poisonous Insecticides and Fungicides.

## CONTACT INSECTICIDES.

Lime-sulphur (commercial).  
 Lime-sulphur (home-made).  
 Nicotine.  
 Kerosene emulsion.  
 Distillate emulsion.  
 Crude oil emulsion.  
 Whale oil soap.

## POISONOUS INSECTICIDES.

Arsenate of lead.  
 Paris green.  
 Arsenite of zinc.

## FUNGICIDES.

Bordeaux mixture.  
 Lime-sulphur (commercial).  
 Lime-sulphur (home-made).  
 Lime-sulphur (self-boiled).  
 Iron-sulphid (see Apple Mildew).  
 Atomic and Milled sulphur.

## SPRAY FORMULÆ.

## Lime-Sulphur—Commercial.

Practically every insecticide company manufactures lime-sulphur, consequently there are a great many different brands on the market, most of which are good. This material comes in liquid form and is diluted with water, using 1 part of the liquid to 10 parts of water for a dormant spray, and 1 to 35 for summer use on apples.

## Lime-Sulphur—Home-made.

Stone lime -----	40 pounds.
Sulphur -----	30 pounds.
Water -----	100 gallons.

*Preparation.*—Bring about 50 gallons of water to a boil in some suitable vessel, or a sufficient amount for slaking the 40 pounds of lime. Add the sulphur and mix as well as possible with the water. When the water is hot put in the lime, which will slake almost instantly with the generation of a great amount of heat. This is desirable, as it helps effect a combination of the lime and sulphur at the start. The mixture should

now be boiled for at least 45 minutes. When finished it is a bright red color, which often turns olive green upon further boiling. There is no danger of boiling too long, but on the other hand too little boiling may be responsible for a poor spray.

Lime-sulphur is one of our best insecticides, as well as fungicides.

#### Nicotine.

For the various plant lice which affect apples there is nothing better to apply during the summer season than nicotine, in some form or other. The most commonly used nicotine spray is Black Leaf "40," and it is usually applied at the strength of 1 part of water to 1000 parts of the nicotine solution. The addition of 5 pounds or more of soap to 100 gallons of the diluted spray adds to its efficiency.

#### Kerosene Emulsion.

Water .....	1 gallon.
Kerosene .....	2 gallons.
Hard soap .....	1 pound.

*Preparation.*—Bring the gallon of water to a boil and dissolve the soap in it; while hot add the kerosene, agitating the mixture violently for fifteen minutes or more. A cream-like emulsion should be formed, which will mix readily with cold water. A stock solution, containing 66 $\frac{2}{3}$  per cent oil, is obtained by this process, and may be diluted to any desired strength.

H. F. Wilson, of the Oregon Agricultural College, gives a simple method for determining the strength to be used, which is as follows: Divide 200 by the per cent desired, and subtract 3; this will give the amount of water necessary to add to each 3 gallons of stock solution for the desired per cent. Example: A 15 per cent solution is desired; 200 divided by 15 equals 13 $\frac{1}{3}$ , minus 3 equals 10 $\frac{1}{3}$ ; this amount of water added to 3 gallons of stock solution will give the 15 per cent emulsion.

#### \*Distillate Emulsion.

Distillate (28° Baumé) .....	20 gallons.
Whale oil soap .....	30 pounds.
Water to mix .....	12 gallons.

*Preparation.*—Dissolve the whale oil soap in the water, heating it to the boiling point; add the distillate and agitate thoroughly while the solution is hot. For use add from 10 to 20 gallons of water to each gallon of the above mixture.

#### \*Crude Oil Emulsion.

Water .....	175 gallons.
Liquid soap .....	3 gallons.
Crude oil .....	25 gallons.

*Preparation.*—Fill the spray tank with the 175 gallons of water; add the liquid soap; agitate thoroughly for one minute, after which add the crude oil, continuing the agitation.

\*Copied from "Injurious and Beneficial Insects of California," by E. O. Essig.

If the liquid soap can not be had, use 20 pounds whale oil soap, dissolved in 10 gallons of boiling water, to which 3 pounds of lye have been added.

#### Whale Oil Soap.

This soap is often used in combination with nicotine sprays, to increase their penetration and spreading qualities. Alone as a spray for apple aphids it is very valuable, when used at the strength of 1 pound of soap to 5 gallons of water.

The ordinary form of this soap has to be melted before being used. There is, however, a liquid form on the market which is much more conveniently handled.

#### Arsenate of Lead.

This is the most commonly used arsenical spray in the apple orchard, and ordinarily is applied at the strength of 3 pounds paste to 50 gallons of water. This amount is sufficient to kill codling moth, canker worm, tent caterpillar and other larvæ which feed upon foliage and fruit. A powdered form of arsenate of lead is also on the market and should be used according to the directions on container.

#### Paris Green.

In the past this arsenical poison has been very extensively used in spraying for the control of chewing insects, but its use has been superseded by the safer and generally better arsenate of lead. For codling moth and other chewing insects it should be applied at the strength of  $\frac{3}{4}$  pound to 100 gallons of water. On account of the likelihood of there being more or less soluble arsenic in the Paris green, which may blight the foliage, lime in small quantities should always be added to the spray. Five pounds of stone lime, slaked, to every 100 gallons of liquid is sufficient.

#### Arsenite of Zinc.

The above is one of the newer arsenical insecticides, and gives splendid results in killing certain insects, which are more or less resistant to arsenate of lead poisoning, as well as all those for which the arsenate of lead is used. It is a less stable compound and for that reason considerable damage has been done to trees and fruit because of its having burned the foliage. It is probably safe for the calyx application in spraying for codling moth.

#### Bordeaux Mixture.

Copper sulphate .....	10 pounds.
Stone lime (unslaked) .....	10 pounds.
Water .....	100 gallons.

*Preparation.*—The copper sulphate is first dissolved by suspending the weighed amount in a sack, in a sufficient quantity of water. The lime is slaked in an equal amount of water and the two liquids poured together into the spray tank, where the agitator will keep the liquid properly mixed.

This is one of the oldest fungicides, and one which we might term the standard.

Lime-Sulphur (Self-boiled).		
Stone lime	-----	8 pounds.
Sulphur	-----	8 pounds.
Water	-----	50 gallons.

*Preparation.*—The preparation differs from that of the home made boiled lime-sulphur, in that only the heat of the lime, which is generated during the slacking process, is utilized. It is made in a barrel or tank, which may be covered tightly to retain the heat for about 15 or 20 minutes, when a slight amount of the sulphur and lime will have combined. It is diluted with cold water, after being strained.

In some of the states to the east the self-boiled lime-sulphur alone, or in combination with arsenate of lead, has been used very successfully for apple scab and mildew, but has not been generally recommended under California conditions.

#### Atomic or Milled Sulphur.

Very finely divided sulphur may now be purchased for spraying purposes. The forms known as "Atomic" and "Milled" sulphurs are commonly used for mites with great success, and are excellent mildew fungicides. The directions for mixing come with the packages.





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